Technical Report 1136

Distant Leadership Under Stress

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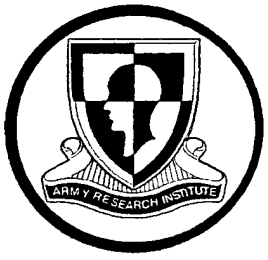

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This project was initiated to develop a phenomenology of team leadership and distant leadership in a highly dynamic, potentially extremely stressful domain: trauma patient resuscitation. A series of five studies were conducted to understand team leadership in trauma teams. One of the studies was a field experiment in which the location of the team leader was assigned to a distant location connected to the rest of the team through telecommunication linkages. The studies used a variety of qualitative and quantitative methods. In contrast to previous frameworks of leadership, the current project depicted detailed team leadership processes and structures critical to the success of action teams. These processes include adaptation of team structures in response to task urgency, team experience, and distance; the fluidity of leadership functions performed by various members of a team; and a multitude of leadership functions. The contribution of the project should be mainly in its depiction of the complex and fluid nature of team leadership for teams that are multi-disciplinary, highly learning oriented, and the hypothetical impacts of distance. The project laid out a new foundation for future research of team leadership in collocated as well as distributed teams.

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Personnel, Performance and Training

FOREWORD

The United States Army is rapidly moving toward the idea of a more flexible, adaptable, and small team-based fighting force. The idea behind this shift is that such a force would more easily be able to respond to the ever changing and uncertain environments in which Army personnel are being asked to serve. The recent conflict in Iraq is an example of how the Army is attempting to introduce smaller, faster, and more flexible units into its battle plans. As such, understanding how such small flexible teams perform under stressful situations and how leaders of those teams can best respond, adapt, and lead is of great interest.

The Research and Advanced Concepts Office (RACO) of the U.S. Army Research Institute for the Behavioral and Social Sciences has long supported research in the area of leadership and has more recently sponsored a number of projects dealing with adaptability, flexibility, and leadership under stressful conditions. This report details one such effort. The work by Xiao and his colleagues represents a systematic effort to better describe and understand how stress, distance, and uncertainty affect leadership and team performance. Through a series of qualitative and quantitative methods and laboratory and quasi-experimental field studies, the investigators dug deeply into team leadership under stress and report a number of interesting and thought-provoking findings regarding how leaders do and should behave in such situations. The results of this effort provide useful insights into team leadership and how it might better be understood and studied.

This research effort is a step in understanding the complexities of team leadership under stressful conditions. Additional research will be necessary to better understand how teams and leaders might be selected, trained, and assessed to maximize the performance of each.

SCOTT E. GRAHAM
Acting Technical Director

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This project was collaborative efforts from the investigators from two institutions (University of Maryland, Baltimore and University of Maryland, College Park), with support from a number of people. Without the support this project would not have been possible.

We would like to thank the project monitors from the Army Research Institute: Michael Drillings, Paul Gade, and Jonathan Kaplan. They provided much needed encouragement and guidance to this project as well as specific technical help throughout the project.

The leadership and clinicians in University of Maryland R Adams Cowley Trauma Center provided access to the clinical settings, participated in the design of the experimental procedures used in the project, volunteered as research participants, and performed as subject matter experts in interview studies and analysis of video recordings. Among the many nurses, residents, medical students, fellows, technicians, and attending physicians who helped, we would like to thank specially Grant Bochicchio, William Chiu, Richard Dutton, Victor Gustina, Jennifer Perry, and Lynn Smith.

The students working at the Human Factors & Technology laboratories were essential to this project; they helped in data collection and data analysis. We would like to thank Jacqueline Moss, Rebecca Roys, Kathleen McGrow, and Soekhwa Yun.

The key part of the project, audio-video recording of live trauma cases, was made possible with the able support of several people. Peter Hu designed the data acquisition system. Paul Regnault provided technical assistance in ensuring the telecommunication and audio-video recording system.

Finally, the Human Research & Engineering Directorate of Army Research Laboratory at Aberdeen Proving Ground provided expert contribution to the project in measurement of stress. We would like to thank Debbie Patton, Pam Burton, Terri Branscome and Linda Fatkin for providing guidance in design of stress measures and in analysis of stress data collected.

EXECUTIVE SUMMARY

Research Requirement:

The army of the future will require leaders and soldiers who are flexible and adaptable in novel missions and operational situations, and teams that can function collaboratively and effectively when quickly formed and/or operating in distributed, high stress environments. This project was initiated to develop a phenomenology of team leadership and distant leadership in a highly dynamic, potentially extremely stressful domain: trauma patient resuscitation. In this domain, the incoming workload is uncertain as trauma patients of unknown injury may be brought to a trauma center at any time; the team is highly specialized and trained; the stakes are high as the patient's life is often on the line. The domain provided an invaluable window through which team activities could be studied in detail, in situ and in real life tasks in which team members had inherent interests in outcomes.

Procedure:

A series of five studies were conducted to understand team leadership in trauma teams. One of the studies was a field experiment in which the location of the team leader was assigned to a distant location connected to the rest of the team through telecommunication linkages. The studies used interviews, observational techniques, surveys of multiple respondents from trauma team members, video analysis of team activities, questionnaires after studied trauma patient care sessions, and communication analysis.

Findings:

In contrast to previous frameworks of leadership, the current project depicted detailed team leadership processes and structures critical to the success of action teams. These processes include adaptation of team structures in response to task urgency, team experience, and distance; the fluidity of leadership functions performed by various members of a team; and a multitude of leadership functions.

Utilization of Findings:

The contribution of the project should be mainly in its depiction of the complex and fluid nature of team leadership for teams that are multi-disciplinary, highly learning oriented, and the hypothetical impacts of distance. The project laid out a new foundation for future research of team leadership in collocated as well as distributed teams.

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Chapter 1. Introduction

The ubiquitous use of new communication technology has fundamentally changed the functioning of teams. Little is known about how communication technology will impact on leadership effectiveness when leaders and team members are separated by distance yet linked by telecommunications. To understand the potential benefits and adverse impact of communication technology on leadership and on team performance in the information age will need empirical data, new concepts, and new theoretical frameworks.

Teams are becoming increasingly common as the primary work unit in many organizations. Accompanying this organizational design shift has also been an increase in many areas of research on teams (see Guzzo & Dickson, 1996; Guzzo & Shea, 1992 for an overview). However, a notable exception to this increased research has been the study of team leadership. This gap in the research literature is somewhat paradoxical as many observers have noted the importance of leadership for work team effectiveness (e.g., Kozlowski, Gully, Salas, & Cannon-Bowers, 1996; Manz & Sims, 1987; Stewart & Manz, 1995). Thus, in order to fully understand the role of teams in organizations, there must be an increase in research on team leadership in a wide variety of contexts (Hollenbeck, Ilgen, & Sego, 1994).

Effective leadership in teams is a key to successful team performance. Incident investigations (e.g. Weiner et al, 1993) and laboratory experiments (e.g., Swezey & Salas, 1992; Orasanu & Salas, 1993; Chemers, 1997) demonstrated a crucial yet intricate relationship between leadership and team performance. Designers of training programs, organization structures, work procedures, and communication networks can benefit from understanding how leaders direct their influence.

In both civilian and military context, geographically distributed teams exploit new communication technology to support coordinated activities and to project expertise and resources over distance. Great access to remote information and easy ways to exchange information remotely because of communication technology pose key questions for those who design training programs, organization structures, work procedures, and telecommunication networks. How does a leader lead a team via mediated communication at a distance, in comparison to when in a face-to-face setting?

This project was to address two major areas in understanding of leadership: team leadership in highly skilled teams and leadership in distributed teams. Although there have been extensive research efforts on teams and leadership, leadership roles are usually examined in the context of organizations (Vecchio, 1997). With a few notable exceptions (e.g. Vroom & Yetton, 1973), few efforts were directed to detailed account of the **processes** by which leaders exert their influence. Research on teams (e.g., Swezey & Salas, 1992), on the other hand, has rarely focused on the role of leadership. Consequently, it is not well understood what function leaders serve in terms of enhancing team performance.

In terms of team leadership. This project attempted to study teams in mission critical environments under stress. In contrast, examples of the tasks sampled in experimental or observational work include composing recruit letters and re-assembling pistols (Fiedler, 1966). Recent examples include those involved in managerial tasks (Vecchio, 1997). Secondly, this project attempted to contribute to the measurement of team leadership effectiveness. In contrast, much previous efforts have been on attitude. The effect of training on leadership consequently is primarily measured by attitudinal changes (as opposed to by changes in, for example, performance). Thirdly, there lacks a process explanation of leadership during dynamic tasks. In other words, it is unclear how leaders influence team performance. One influential line of research is the crew resource management approach (Wiener et al, 1993) to team coordination and leadership. Although a significant contribution, this approach focuses on inter-personal relationships and attitudes. To paraphrase Hackman's (1993) criticism, the crew resource management approach requires that effective leaders should encourage others to challenge their decisions forcefully, but not too forcefully.

In terms of distributed teams, previous work on team leadership and teams has primarily been formulated based on the assumption of face-to-face, co-locating settings. There is a growing body of research on group behaviors through mediated communications (such as email, audio-video conferencing links, etc); however, much of this line of research (often referred to as computer supported collaborative work or CSCW) focuses on managerial, business document production tasks, etc. Little is known about performance of spatially distributed teams in task situations where decisions are made under real-life stress with experienced decision-makers, and when the team task is highly technical, performed under time pressure, and has high stakes. Fundamental differences in tasks and team composition between those in prevalent studies and those found in many mission critical work environments are such that little data exists to guide designers of teams and communication systems (Kozlowski, et al, 1996; Avolio, Kahai, & Dodge, 2001).

This project on distant leadership under stress conducted a series of studies, including a field experiment on distant leadership, in a high-stakes, real life setting: trauma patient resuscitation. The task environment in which trauma teams work bears many similarities to the types of environments found in other settings. First the performance is team oriented: expertise from multiple professions is needed. Members of a trauma team usually have years of experience and high levels of expertise in their work domain Second team activities are driven by events that are dynamic and often evolve separately. This is in contrast to "intellectual teamwork" where events external to the teams can often be omitted in research (e.g. Galepher, Kraut, & Edigo, 1990). Thirdly, trauma teams are frequently confronted with high task urgency and uncertainty. Decisions are often to be made under extreme time pressure with many unknowns about the patient and injuries. Lastly, the stakes of team performance are often extremely high and can be life or death of the patient.

Some have labeled the type of teams such as trauma teams as action teams: "highly skilled specialist teams cooperating in brief performance events that require improvisation in unpredictable circumstances" (Sundstrom, De Meuse, & Futrell, 1990, p. 121). Individual members of the team perform specialized tasks and the effectiveness of the team rests in the ability of the team to coordinate and integrate these individual member performances. Action

teams often consist entirely of expert specialists who come together for brief performance events (Sundstrom et al., 1990). Action teams perform tasks that are highly structured; however, these tasks are performed in dynamic environments (Kozlowski, Gully, McHugh, Salas, & Cannon-Bowers, 1996). Individual members of the team perform specialized tasks and the effectiveness of the team rests in the ability of the team to coordinate and integrate these individual member performances. Common examples of action teams include cockpit crews, combat teams, sales teams, negotiation teams and, in the present study, shock trauma medical teams. Action teams provide a fruitful avenue for the study of team leadership because these types of teams will grow increasingly common in civilian and military contexts.

Overview of the project and the report.

The project was designed to be carried out by researchers with background from a range of disciplines and to exploit several methodologies in understanding distant leadership under stress. Five interrelated studies were conducted in a natural laboratory of action teams: the patient admitting area of a level I trauma center. Chapter 2 will review the existing literature and Chapter 3 describe the study setting.

Study I (Chapter 4): an observational and interview study. Study I was designed to address basic questions on team leadership in highly specialized and trained action teams, such as who is the team leader and what a team leader does.

Study II (Chapter 5): case studies of team leadership scenarios through review of archival video and other data. An existing video library was used to generate scenarios in which team leadership was judged either important or missing but could be important if provided.

Study III (Chapter 6): a survey study of leadership behaviors in terms of impact and occurrence frequency. The respondents were from care providers who constituted trauma teams in the studied trauma center.

Study IV (Chapters 7 and 8): a quasi field experiment manipulating leader locations. In the experiment the most senior member of a trauma team was assigned either to be co-located with or remote to the reset of the team.

Communication analysis (Chapter 9): an analysis of inter-personal verbal communication recorded in Study IV to understand adaptation of team structures to variables such as task urgency, shared team experience, and distance.

Study V (Chapter 10): an in-depth interview study on team leadership to propose new constructs, such as team leadership systems.

Video analysis (Chapter 11): a grounded-theory approach to qualitative video analysis on the phenomenon of team leadership. Episodes were extracted to describe leadership functions and task situations.

The findings of the project are summarized in Chapter 12, with suggestions for future studies on distant leadership under stress and team leadership.

Chapter 2. Distance and team leadership: A selected review

As an important topic, leadership has been under investigation within and beyond a military context. Much has been published on the topic as represented by Fiedler (1967), Vecchio (1997), and Chemers (1997).

Team Leadership Theory

One of the earliest conceptualizations of critical leadership functions necessary for group effectiveness was presented by McGrath in the 1960s (Kogler Hill, 1997). McGrath developed a functional model of leadership that specified two types of critical leadership functions, monitoring and taking action, with two types of foci: internal focus and external focus. The two leadership activities (monitoring and taking action) can be crossed with the two potential orientations (internal and external) in order to obtain four different team leadership functions. A monitoring/internal orientation is characteristic of diagnosing group deficiencies, a taking action/internal orientation consists of simply taking action to correct group deficiencies, a leader with a monitoring/external orientation would forecast environmental changes, and an action/external oriented leader would take preventative action due to environmental changes. Thus, this model presents four team leadership functions that can be carried out by an individual in order to obtain group effectiveness.

Hackman and Walton (1986) extended McGrath's functional perspective and conceptualized a leader as an individual who designs, builds, and maintains effective work groups. These authors hypothesized that in order for groups to be effective, three critical components must be present: a clear, engaging direction, an enabling performance situation, and adequate material resources. Thus, Hackman and Walton (1986) conceptualize team leadership as the functions that must be performed in order to satisfy these three components of an effective team. Similar to McGrath, these functions of the team leader include behaviors such as monitoring current and future conditions as well as taking action to improve the critical group components.

In addition to this functional perspective, another viewpoint of team leadership comes from the research on self-managing teams. Stewart and Manz (1995) develop a model of team leadership for self-managing teams based on the conclusions of Bass (1990). Specifically, Stewart and Manz (1995) create a 2 X 2 matrix based on Bass' (1990) conclusions that leadership varies on a continuum from autocratic to democratic and that leader activity can range from high involvement to very little involvement. Thus, four different types of team leader behaviors emerge, as illustrated below.

First, an overpowering team leader is one who is involved and autocratic. The general leader behaviors of an overpowering leader include coercion and autocratic decision making. A leader who is passive and autocratic results in powerless leadership which is characteristic of lack of direction and alienated teams. An active leader who is democratic is characterized as a power building team leader who provides guidance and encouragement, delegation, and reinforcement. Finally, a passive democratic leader results in empowered leadership with

behaviors such as modeling, boundary spanning, and assisting. Stewart and Manz (1995) state that a passive, democratic style of leadership truly empowers the team allowing it to design work processes and be self-governing. According to the authors, there are several antecedents which influence what type of team leader behaviors are displayed. These antecedents include personal characteristics of the team leader (need for power, need for affiliation, education), situational characteristics of the team setting (culture, definition of leader role in organization), and the team leader's perceptions (efficacy). These antecedents lead to one of the four primary types of team leadership (overpowering, powerless, power building, empowered) which in turn have an impact on team effectiveness, development, and productivity.

While these team leadership models provide important foundational insights, team leadership theories of action teams are of particular importance to the current project. Accordingly, Zacccaro and Marks (1999) state that leaders of action teams "need to be especially attuned to performance conditions in the operating environment so that the team is aware of the parameters required in its responses" (p. 119). Further, team leaders of action teams must facilitate coordination among the members of the team as well as monitor members of the team in order to ensure that individuals are capable of carrying out their specific task.

A more developed model of team leadership of action teams has been presented by Kozlowski, Gully, Salas, et al. (1996). Specifically, in this model the role of the team leader in action teams is to develop member skills and to foster and maintain coordination among the team. Kozlowski, et al. (1996) develop an input-process-output model in which task attributes such as complexity, ambiguity, and tempo are inputs, enabling processes such as communication, coordination, and adaptation are processes, and team effectiveness measures such as accuracy, speed, and consensus are outputs. Team leadership is positioned in the model as an additional input that influences task attributes. Specifically, team leadership consists of both developmental and task contingent behaviors. Thus, one must take into account the context of the behavior in which, under low load situations, the leader creates experiences that instruct the team to develop shared knowledge of the team and its task. Under high load conditions, the leader takes advantage of this shared knowledge to prime the team and to maintain common understanding within the team as the external situation changes (Kozlowski, et al., 1996, p. 260).

In addition to impacting task attributes, team leader behavior also influences the process of team coherence which can essentially be viewed as a shared mental model among team members. Thus, team leaders influence team members shared understanding of climate and cohesion of the team along with clarifying goals, strategies, and role expectations.

Kozlowski, et al. (1996) expanded upon this model through greater elaboration of the developmental and task contingent roles of the team leader. Specifically, team leaders develop team coherence and a shared mental model through definition of the social structure, coaching of individual members, and definition of the team's function. Kozlowski, et al. (1996) expand on the task contingent roles of the leader by dividing it into two separate functions: instruction and intervention. The team leader develops team coherence and competencies with instruction during low intensity tasks. During high intensity tasks, the leader engages in intervention through monitoring the situation and redefinition of the roles and tasks of the team. Thus,

Kozlowski, et al. (1996) model of team leadership of action teams suggests that leadership involves both developmental and task contingent roles.

While not an exhaustive review, the prior discussion has attempted to highlight the diverse perspectives and theories regarding team leadership. Integration and comparison of each of these different team leadership theories illustrate similarities, gaps, and discrepancies that lead to several research questions. First, it is apparent that these models differ in complexity and breadth. Some models only postulate and explore simple 2 X 2 relationships (e.g., Stewart & Manz, 1995) while other models attempt to take into account many more predictors and contingency factors (e.g., Kozlowski, Gully, Salas, et al., 1996). Next, some of these models attempt to apply to many broad instances of team leadership (e.g., Hackman and Walton, 1986) while others are focused on more narrow facets of team leadership such as self-managing or action teams (e.g. Kozlowski, et al., 1996).

Functions and behaviors of leaders

Existing leadership theory and research are dominated by a focus on the formal organizational or departmental leader. However, both early and recent conceptualizations of leadership suggest that leadership behaviors may be presented not only by the formal leader but by other team members as well.

French and Raven's (1959) conceptualization of leader power suggests that formal team leaders are likely to have substantial legitimate, reward, and coercive power over team members, but they may lack expert power. If so, then a team may have two or more leaders: the formal team leader and the expert leader(s). Emerging conceptualizations of leadership suggest, however, that leadership may be shared not just by the formal leader and one or more expert leaders, but by other team members as well (e.g., Avolio, Sivasubramaniam, Murry, & Jong, 1999). Thus, team members who are neither the formal nor the expert leaders may nevertheless engage in task leadership behaviors (as in "I'll handle X task, so why don't you do Y task, ok?"), relational leadership behaviors (as in "Hey, you did a really good job with that"), and even transformational leadership behaviors (as in "Have you heard how well Joe's team is doing with the new procedure? There's no reason we can't do that, too").

As the Army relies more and more on interdisciplinary teams (e.g., multinational civilian and military teams engaged in peace-keeping missions), questions about who can and should perform which leadership functions within a team gain new relevance and importance.

Models based on personal traits. Social influence has been viewed as the key element of leadership, as articulated in a definition by Chemers (1997): "leadership is a process of social influence in which one person is able to enlist the aid and support of others in the accomplishment of a common task". Fiedler (1967) proposed a seminal theory on leadership effectiveness, the contingency model. This model prescribes a three way relationship between group performance and leadership style, task structure, and leadership influencing power. The leadership style in this model is classified into two: task-oriented and relationship- or person-oriented. Task-oriented leaders value the goal of achieving tasks whereas relationship-oriented leaders aim at personal relationships with members. Leadership style is considered to be part of personal trait and thus can be used in personnel selection. Task structure

is the characteristic of a task in terms of how well it is defined. Leadership influencing power is the degree to which a leader applies social influence, either through being in a formal leadership position or being in a good relationship with members. Worded differently, the contingency model predicts that there is no single best leadership style for achieving best group performance. According to the model, for highly structured tasks, relation-oriented leaders may find it difficult to function as leaders; whereas for highly unstructured tasks, task-oriented leaders would have little to rely on to achieve the objectives. Two corresponding extreme examples are assembly tasks and committee tasks. The contingency model has found broad support (Strube & Garcia, 1981).

Models for managerial tasks. In contrast to the contingency model, Vroom and Yetton (1973) advanced a model on how leaders influence the process of decision making in managerial tasks. Their model attempts to capture desirable decision making processes used in a managerial context. These desirable processes reflect the different levels of participation by members in decision making, either in providing information or in reaching a decision.

Team leadership and team structure

Teams can be viewed as work groups that have each member assigned specific roles (Salas, et al., 1992; Brannick & Prince, 1997). A well-functioning team in many real-life settings is more than a collection of members, but with structures for communication, accountability, learning and development objectives, and for professional expertise (Kozlowski et al, 1996; Nygren & Levine, 1996). Team structures, or how a team is organized to perform, seem to be the differentiating feature that makes a group of individuals a team.

The existence of team structure poses challenges to conceptualization of leadership in teams, as leadership is often assumed by a team as opposed by one designated leader (Cox & Sims, 1996; Sivasubramaniam et al, 2002). Although in nearly all studies of intra-team communications, the teams studied have members equal in experience (e.g. George et al., 1990; Sosik, Avolio, & Kahai, 1997). In many teams in real life settings, however, there are often differentiations in terms of experiences among the team members. Some of the team members may be well experienced whereas others have relatively less experience. Such differentiation in experience may allow multiple members of a team to enact leadership. The most senior member of the team, for example, may choose to make the second most senior member take control of team activities. As another example, more experienced team members may choose to take on less responsibility to give those with less experience opportunities to learn. As a result, the team may choose a spectrum of communication configurations. At one end of the spectrum, the communication connections occur solely along the gradient of experience. The most senior member will only communicate with the second most senior member and so on and so forth. At the other end of spectrum, everyone communicates with everyone else in the team. As a point in the spectrum, the team leader (the most senior in terms of experience) communicates with everyone but the rest of the team members do not communicate with each other. The team may choose a communication configuration in response to tasks and environment. Similarly, in a multi-disciplinary team different members may lead the team activities when the required expertise may change over time. The team leader may carry ultimate authority but she or he in such teams often does not have monopoly powers in technical expertise. As a result, the team may vary its structure to accommodate such changes.

Bolman & Deal (1997, pp. 82-93) used the example of a high-performing commando unit to illustrate how the unit changed team structures when the unit changed from planning phase to execution phase of a mission. There has been little research examining the adaptation process of teams. In highly technical, uncertain, high-risk work domains, one can argue that such adaptation is essential for successful performance.

An understanding of team structure can provide us with insight into the process by which team members work together and the impact of leadership. It also provides a basis for designing teams and communication technology support. One approach to studying team structure is to characterize communications among team members. In Tushman's (1979) study, for example, self-reported communications were separated into two categories: horizontal or peer-to-peer and vertical or supervisor-subordinate. The ratio of communications in the two categories was used to measure team structure in terms of centralization of communication. The centralization-decentralization dichotomy provides a first step in understanding team structure. However, this simplification of team structure may not be adequate to capture the variations of teams in work settings.

Much effort has been invested in designing team structure so that it fits the demand of tasks. In many work settings, a number of factors shape team structure. In addition to task characteristics (Tushman, 1979), a team may change how its members communicate as the team gains experience in working together (McGrath, 1991), and may centralize decision authority under stress (Driskell & Salas, 1991). With the ubiquitous use of telecommunication technology, geographically distributed teams have to adapt their structure in order to effectively exploit mediated communication.

Task, team, and environment variables impacting on distant leadership

Media richness and distributed teams. What happens when the leader of a team is at a distance? One body of literature to draw possible answers to this question is from the field of computer-supported cooperative work (CSCW). When a team works through medicated communication, in comparison to face-to-face, a number of changes occur to how they interact, often as a function of the medium used in communication.

Cohen (1982) reported a study comparing group communications between two conditions: face-to-face and mediated by video teleconference. Video teleconference condition produced more orderly turn taking and fewer speaker exchanges that were viewed as interruptions. Face-to-face produced more interruptions, almost twice as many speaker exchanges. Face-to-face meetings were more interactive, less orderly, and less polite than video teleconferences. Based on this study, one may suggest that distance induces more formality in team communication. As a result, a distant leader may be less flexible in changing communication patterns in response to contingencies and unanticipated events.

In addition to increased formality in communication, mediated communication has been found to be limited in conveying perceptual cues used in team interaction when compared with face-to-face setting. Several studies have uncovered the advantages of physical proximity among

team members. When team members interact in co-located settings, shared visual fields allow more fluid and efficient information exchange. Fussell, Kraut, and Siegel (2000) explained the beneficial effects of co-presence based on the grounding theory of communication proposed by Clarks and his colleagues (Clark & Marshall, 1981; Clark & Wilkes-Gibbs, 1986; Clark & Brennan, 1991). The grounding theory of communication states that interpersonal communication is conducted at two levels: establishing a common ground and exchanging substantive information. The process of grounding is to establish common knowledge of what is communicated and what is understood. Fussell et al (2000) proposed that three types of tasks of establishing common ground are carried out: establishing joint focus of attention, monitoring comprehension, and pursuing conversational efficiency. Physical proximity allows the transmission of perceptual cues that facilitate the accomplishment of all three tasks. The proposal by Fussell et al (2000) explained well the findings of several studies on interpersonal interactions in co-locational settings (e.g. Krauss et al, 1977; Bellotti & Rogers, 1997). To provide these perceptual cues in mediated communication settings, technology solutions have been tested, such as provision of remote gesture pointer (Kuzuoka et al, 2000) and sharing of workspace (Gutwin & Greenberg, 1998). These studies suggest that the impact of distant leadership will be determined by the telecommunication technology deployed in terms of perceptual cues provided.

The effect of rich medium in inter-personal interaction, such as that afforded in face-to-face settings, on team performance is probably task dependent (Finholt, Sproull, & Kiesler, 1990; Valacich, et al, 1994) and time-dependent (McGrath, 1990; 1991). For example, Weisband et al. (1995) reported that the effect of communication modality on leadership influence is small comparing to other factors, such as status labels. As another example, McGrath (1990, 1991) and his colleagues (McGrath, et al, 1993; Straus and McGrath, 1994) concluded that when teams gain experience in working together, the need for communication decreases and the teams are less reliant on medium-rich model of communication (such as face-to-face meetings). These studies suggest that task context, along with telecommunication technologies used, is a determinant of how distant leaders impact on team performance.

Experience and team performance. A major criticism, as articulated by Kozlowski et al (1996), on the studies on distributed collaborative work and teams is that much of the empirical efforts have been on teams that have relative short history performing contrived tasks with few meaningful consequences. Establishing an empirical and theoretical basis for studying distant leadership would provide valuable guidance to systems design and personnel training (Avolio, Kahai, & Dodge, 2001).

Impact of stress on leadership. Stress has been studied in the context of leadership. Fiedler & Garcia (1987) reported the strong moderating effect of stress on group performance against personal traits, intelligence, and task structure. Under high stress, directive leaders with experience were found to be more effective and little impact was found from the leaders' intelligence. Again, Fiedler & Garcia's study did not examine the detailed impact of stress on leadership. Rather, it used a methodology similar to many other leadership research efforts that focused on the correlation between personal trait (leadership style) and performance

The threat-rigidity thesis, examined by Driskell & Salas (1991), in contrast, postulates a relationship between stress and the leadership process. In this case, the leadership process was

control of decision-making. The thesis hypothesizes that, under stress, members defer their decisions to the leader while at the same time the leader attempts to centralize authority and ignores team members' inputs. Through experiments, Driskell & Salas (1991) were able to provide supportive evidence for the threat-rigidity thesis and also discovered a "flattening" effect of stress: stress would reduce the hierarchy in a team.

One important component of task context is the stress experienced by many teams in real-life settings. The threat-rigidity thesis, examined by Driskell & Salas (1991), makes inferences on the impact of stress on team processes. The thesis hypothesizes that, under stress, members defer their decisions to the leader while at the same time the leader attempts to centralize authority and ignores team members' inputs. Through experiments, Driskell & Salas (1991) were able to provide supportive evidence for the threat-rigidity thesis and also discovered a "flattening" effect of stress: stress would reduce the hierarchy in a team. Such prediction leads to important and interesting questions on team processes when teams are led by distant leaders while under stress: would teams retain their structure in communication, as suggested by the study by Cohen (1982), or change their structure under stress, as suggested by the thread-rigidity thesis?

Leadership and communication processes. The classification of leadership styles into task-oriented versus relationship-oriented has its inherent prediction of the communication processes. Fiedler (1967) summarized a procedure used in a content analysis of communication. In this procedure, communication contents were categorized by whether communication was task-related or relationship-related. Communications such as "you start", "let's not work on that", etc., were considered to be related to tasks, whereas personal remarks, pleasantries, and jokes (tension relieving) are more relationship-oriented. The proportion of relationship-oriented comments was found to be higher for those from relationship-oriented styled leaders than that from task-oriented styled leaders.

Face-to-face communications carry many informal and redundant cues through auditory and visual channels, and video conferencing systems often are unable to provide these cues (e.g., Krauss, et al, 1977). Even with the rather elaborate system described by Abel (1990), users still did not communicate in the same way when they did at the same site (e.g. conversations were never as intimate as those carried out face-to-face). Using a survey methodology, Michailidis and Rada (1997) compared electronic mail, face-to-face, fax, post, and telephone in terms of coordination (commitment management, decision-making, awareness, communication, transparency, and perceptions). Face-to-face was the most effective mode of communication.

Task characteristics and communication. Characteristics of tasks by themselves may change a team's ability to function and to communicate. McGrath (1984), after realizing this possibility, proposed a task matrix, which was used to predict the need for communication. The task matrix (Group Task Circumplex) describes a group task along two dimensions: cognitive-behavior and collaboration-conflict resolution. In a manner very similar to that used by Fiedler in his eight quadrants of leadership favoredness, McGrath attempted to establish how task characteristics modify a group's abilities in a given configuration. Because communication modality is one of the key variables of group configuration, the task matrix was used to provide a framework for

studying the impact of communication technology on group performance (McGrath & Hollingshead, 1994).

McGrath's (1984) "group task circumplex" has been used to understand how communication modalities impact on group performance (McGrath & Hollingshead, 1994,McLeod, 1992, McGrath, 1990 & 1991; McGrath, et al, 1993; Straus and McGrath, 1994). The major tenet of these studies is to associate characteristics of tasks (e.g. idea generation, judgment, and multiple choice) and impact of communication modality. Two major findings from their studies are (1) that when groups gain experience in working together, the need for communication is reduced and the importance of high-media communications (such as in face-to-face meetings and in video-conferencing) decreases and (2) that face-to-face communications benefit tasks requiring high levels of coordination.

Communication modality and task performance. Since leadership is often viewed as a type of social influence, whether such influence will change according to the type of communication modality becomes an interesting and important question. Weisband et al (1995) reported that the effect of communication modality on leadership influence is small comparing to other factors, such as status labels.

Shared mental models. Shared mental model (Orasanu & Salas, 1993) is an emerging concept to capture how a team could function together often with little overt communication. The underlying assumptions are that team members, through training, experience and communication, achieve congruent mental models of the current situation, choices available, relevant goals, and future steps. Xiao et al (1998a, 1998b) described several ways in which team members were able to coordinate without explicit communication. Saferty et al (1989) described the effect of workload on communication processes. Under high workload, team members adopt strategies that reduced the need for explicit communications.

These studies all demonstrate that in highly trained teams with experienced members, communication patterns varied and there are ways for leaders to exert influence without explicit communication. In contrast to many previous studies on leadership, verbal activities are usually the only ways in which leaders function. Such difference would have direct bearing on the potential impact of new communication technologies on leadership.

Communication and workload. Verbal communications have often been studied as the major process for coordination (Kanki, Folk, & Irwin, 1991). The concept of "implicit coordination" was introduced when teams were found to be able to coordinate with reduced communications (Serfaty, Entin, & Volpe, 993), especially under high workload situations. To investigate factors promoting implicit coordination, it has been hypothesized that "shared mental models", or shared understanding of goals and tasks, is a key, since division of labor in most work settings prevents team members from understanding other people's tasks. Volpe et al (1996) tested this hypothesis and found that cross training, in which team members were trained in other people's tasks, improved team performance by prompting implicit coordination. The concepts of shared mental models and implicit coordination and related empirical data highlight the issue of communication cost. When workload and time pressure is high, reducing the cost or workload related to

communication has obvious advantages. If it is important for team members to share an understanding of each other's tasks and goals, which are relatively stable, it is equally important for team members to be aware of task situations and each other's activities, plans and work focus, all of which are changing in dynamic work settings.

Communication modality and performance of distributed workers. A research field "Computer Supported Cooperative Work" (CSCW) emerged in recent years to address problems in designing and assessing communication technologies for distributed workers.

Several bodies of literature have been developed to understand and to devise ways to support distributed teams. A number of questions related to distributed collaborative work have been addressed to some extent, such as how face-to-face interactions are different from mediated interactions (e.g. Cohen, 1982; Kraut, Miller, & Siegal, 1996; Kuzouka, et al, 2000; Olson & Olson, 2000), how properties of telecommunication channels impact on styles of distributed work (e.g. Finn, Sellen, & Wilbur, 1997; Herbsleb et al, 2000), and how trust is developed among distributed workers (e.g. Iacono & Weisband, 1997).

Ellis, et al (1991) proposed a taxonomy to describe communication media: (1) same place or distributed across locations, and (2) synchronous or asynchronous. Electronic mail, for example, is a medium that allows exchange of information asynchronously among people at different places. In comparison, information exchange in face-to-face meetings occurs synchronously and at the same place. Whereas it may seem intuitive that face-to-face communications would be the ultimate medium for collaborative work, Finholt, Sproull, & Kiesler (1990) found that, in certain tasks (software development), teams utilizing electronic mail more were more productive than those using more face-to-face meetings. Valacich, et al (1994) drew a similar conclusion when comparing groups with and without face-to-face communications in an idea-generation task. A recently reported study (Shin et al, 1999) on the choice of communication modalities indicated that communication urgency and perceived reliability of a communication mode influenced the communication media use by geographically distributed workers. The choices of communication modalities in that study were E-mail and telephone, and tasks were those in software development.

Summary

The majority of work on leadership has been oriented towards managerial tasks. The functions performed by leaders are usually focused on managing personal relationships, setting long-term goals and visions, creating a collegial environment, whereas how a team leader applies his or her efforts to make the team function better during dynamic tasks is not well addressed. For example:

- How well does a leader delegate tasks?
- How well does a leader assess the team's overall situation awareness?
- How well does a leader carry out preplanning?
- How did a team leader convince followers to adopt a plan?
- How did the leader solicit information?

Answers to these questions may lead to trainable skills (as opposed to personal traits), requirements for information system design, and prototypical communication patterns for leaders and team members.

While the reviewed models differ in complexity and breadth, it is possible to attempt to synthesize conclusions regarding team leadership across theories. First, a notable omission across these theories is that they fail to describe who is identified as the leader and how he/she came into power. Some models attempt to reconcile this omission by stating that the team leader is the individual who is identified by the organization (e.g., Kozlowski, Gully, Salas, et al., 1996) and therefore has positional power. Other models such as McGrath's suggest that any member of the team can perform the leadership functions, but there is still only one designated leader of the team (Kogler Hill, 1997). In addition to failing to identify who the team leader is and how he/she was determined to be the team leader, the models also fail to describe how the team leader maintains the leadership role and influences the team. Again, many of the models assume that the positional power of the leader will be enough to influence the team (e.g. Hackman & Walton, 1986; Stewart & Manz, 1995); however, the particular means of influence of the leader is not explicitly stated in the team leadership theories. Thus, a question arises from existing team leadership theory as to who is the leader of the team?

Next, it is obvious that each of these team leadership theories articulate behaviors or functions that leaders perform; however, the theories differ in what these specific behaviors are. For example, some models are very general such as McGrath's which articulates the generic view of team leader behaviors consisting of either monitoring or taking action (Kogler Hill, 1997). Indeed, present in almost all of the team leadership models is this general distinction in which the leader can either perform monitoring behaviors or action oriented behaviors. However, only a few models such as those based on the input-process-output model specify what these monitoring or action oriented behaviors are. For example, some specific action behaviors of team leaders that have been identified include coaching of individual members, definition of the social structure, and definition of the team's functions (Kozlowski, Gully, Salas, et al., 1996). Thus, while team leadership theories share the view that the leader can either monitor or take action, there is a lack of specific articulation of the actual behaviors of team leaders. Thus, a question that arises as to what team leaders specifically do?

Finally, team leadership theories differ in the results of the leadership. Specifically, there is a general distinction between theories in which some models state that team leadership has a main effect on group outcomes such as team effectiveness, development and productivity (e.g. Stewart & Manz, 1995) while other models state that the relationship between team leadership and team outcomes is mediated by process variables (e.g., Kozlowski, Gully, Salas, et al., 1996). Thus, these theories state that team leadership has an impact on team processes such as task structure, motivation, shared mental models, et cetera. Therefore, it is necessary to further explore the impact of team leadership and the results of team leadership in order to determine the importance of mediating variables on the relationship between team leadership and team performance. Therefore, a final research question arises that asks what are the results of team leadership?

Chapter 3. Teams in Trauma Resuscitation: A Guide to the Domain

The domain of trauma resuscitation provides an invaluable window into the interplay between stress and team performance. Trauma resuscitation in a dedicated facility is usually performed in a small geographical area and thus it is possible to capture all aspects of team activities. The initial phase of trauma resuscitation has also a limited duration and thus it is possible to study intensively the interaction process among team members. Further, it is possible to manipulate the location of a member of a team through experimental means such that distant leadership can be investigated.

The Domain

Trauma patient resuscitation requires the simultaneous occurrence of maneuvers to stabilize the patient while assessing the injuries sustained by the patient. Typically a trauma center receives notification of incoming patients. The notification usually describes when the patient will arrive, how the patient is injured, and current status of the patient. Although often misleading, the notification provides a team of clinicians some ideas about what types of patient to expect and what special preparation to occur.

The first 10 to 30 minutes of trauma resuscitation after the patient arrival is often guided by a set of steps, or a protocol based on expert consensus. This protocol is known as Advanced Trauma Life Support (ATLS). According to this protocol, the objectives of a trauma team should be, in order of importance and temporal sequence, "ABC": a patent **A**irway, **B**reathing and ventilation, and blood **C**irculation. Typically the patient is assessed for immediate life-endangering injuries through history taking, physical examination and obtaining vital signs (e.g. heart rate and blood pressures). Suspected injuries not directly visible are assessed through diagnostic devices, such as X-ray, computed tomography, and ultrasound machines.

The Research Setting

Our project was conducted in a trauma resuscitation unit (TRU) in a Mid-Atlantic, urban Level-I shock trauma center. The shock trauma center is dedicated to the medical treatment of severely injured patients resulting from motor vehicle crashes, falls, shootings, stab wounds, et cetera. The TRU operates 24 hours per day, 7 days per week and averages 17 new admissions per day (6,217 admissions in 1998). The TRU receives patients directly from the scene and about 40% arrive via Med-Evac helicopter. The TRU was founded in 1961 and has grown from two research beds to the largest freestanding shock trauma center in the world (Scherer, 1989).

The Teams

In the trauma center studied, trauma teams consisted of surgical care providers (attending surgeons, surgical fellows, and surgical residents), anesthesia care providers (attending anesthesiologists, fellows, and nurse anesthetists), and trauma resuscitation unit nurses. A *resident* is a physician in one of the postgraduate years of clinical training. In addition to residency training, a physician may choose to become a *fellow* to undergo additional highly specialized training. A *chief resident* is a resident in the final year of residency training and may

function in the capacity of a fellow. For ease of description, we will refer chief residents as fellows in this report. An *attending physician* is someone who has finished all professional training and was certified to practice in certain specialties.

Typically for each patient admission a trauma team was organized. The surgical members of the team taking care of a patient formed a hierarchy in terms of expertise:

- The **team leader**, the attending surgeon, the most experienced and viewed as the person ultimately responsible for the person (to paraphrase a description given by an informant: "the person who signs the credit card bill"). We will refer the attending surgeon as the team leader.
- the **senior member**, surgical fellow, as the second most senior person
- the **junior members**, residents. Among the junior members usually one of them is assigned as primary physician, who would be in charge of the patient admission. (The assignment was rotated among all the residents.)
- the rest of the residents in second to fourth year of their residency

In addition to surgical members, typically working with them are one or two trauma nurses, one or two anesthesia care providers, one or two technicians, and observing medical students. The number of members in a trauma team in the studied center usually varies from four to fifteen.

Consultative services are available from orthopedic surgery, neurosurgery, plastic surgery, pediatrics, psychiatry, social work, clergy, et cetera. The medical staff is divided into three teams that each work a 24-hour shift every third day. The patient care providers typically work 12-hour shifts. Individual specialists consisting of patient care providers, medical staff, and consultative services assemble to form a team for the cooperative diagnoses, treatment, and stabilization of patients.

The training care providers (residents and fellows) usually changed from month to month in the trauma center studied, as they started their duties at TRU at the beginning of each month and finished at the end of each month. The attending surgery and anesthesiology physicians were in rotations and thus changed from day to day among two to four attending physicians. While taking care of patients, the training members of the team had the goal of learning. In addition to patient care knowledge and skills, the training members also learned how to work together with other members as a team in treating trauma patients.

The team formation for the treatment of a particular patient is based upon a rotation in which the attending and fellow are usually members of every treatment team and take part in the handling of all patients for a given shift, while the residents, medical students, and nurses are members of a patient treatment team in successive order. For example, when four nurses are assigned to a shift, one nurse is a member of every fourth treatment team. Therefore, over a shift, it is likely that there could be a different team of individuals who assemble for each admission.

Even though the attending surgeon is usually considered as the team leader, the team members share the overall responsibility of ensuring the welfare of the patient (Xiao & Moss, 2001). In particular, the non-surgical members of a trauma team often enact leadership from their respective domains of expertise.

As a patient's injuries are usually severe, rapid assembly and treatment of the patient is critical. Indeed, the first hour after injury has come to be know as the "golden hour" due to its importance in successful patient outcomes. Thus, due to the high frequency of admissions in which action teams of specialists must rapidly assemble in a dynamic environment, the TRU provides an ideal setting for the qualitative study of team leadership in action teams.

These treatment teams are action teams: the are comprised of highly skilled specialists who assemble for the performance event of treating a patient. During the treatment, the team may utilize many standard medical procedures; however, these tasks are performed in a dynamic environment as there are uncertainties about incoming workload, patient conditions, and personnel resources. Finally, outcomes and team performance in the TRU are usually dependent on the team's ability to coordinate its individual members' capabilities and efforts (Mackenzie and Lippert, 1999).

Infrastructure for Distributed Team Research

Audio-video data acquisition system. The Trauma Resuscitation Unit (TRU) has 10 identical resuscitation bays, all connected by audio-video-data links to the telecontrol room. All locations have ceiling mounted microphones for audio capture with a dual camera system including one fixed camera and one pan-tilt-zoom camera (Figures 3.1). All locations have an AV switchbox located in them. Audio-video devices connect to a system wide time code generator, which can then be imprinted on recorded material.

The telecontrol room is the hub for the audio-video information that comes from the TRU bays (Figure 3.2). Audio-video information can be viewed on three 27" monitors in the room or bank of 3" preview monitors. Images can be recorded here as well on two VCRs that are attached to the system wide time code generator.

Infrared audio communication system. The Infra Red (IR) Voice Loop Communications system (Temco Communications, Inc., Barrington, IL) was installed in TRU, which includes nine operator headpieces with IR transmission capability (Figure 3.3). These are bone-conducting receiving and standard transmitting microphones built into the headset. The bone conducting receiver microphones are placed in front of the ear so they do not interfere with hearing other team communications or clinical tasks such as insertion of a stethoscope into the ears.

The two-way audio communication system used infrared bandwidth to minimize interferences with other electromagnetic devices. Bone-conducting headphones were used so that the wearer's ear channels were not obstructed for the use of stethoscopes and for regular auditory perception (e.g. communicating with co-located team members, the patient, and listening to signals from patient monitors). The audio system, once activated, allowed hands-free operation. With such a setup, it was technically feasible to manipulate the distance from which the leader of a trauma team collaborated with the rest of the team.

Additionally, ceiling mounted microphones and speakers were installed at each bay and were connected to the distant command center (Figure 3.4). A person sitting in the distant

command center could hear all the sounds in the patient bay. He or she could also speak to everyone in the bay through the ceiling speaker. Alternatively, he or she could speak to individual team members in the bay through the two-way audio communication system.

Infrastructure for field experimentation on distant leadership

The telecontrol center was configured as the distant command center for a distant member of a trauma team to work collaboratively with the rest of the team in the TRU bay. The telecommunication infrastructure allowed for the possibility of field experiments in which a senior member of a trauma team was distant from the patient yet still contributed to the team performance (Figure 3.5).

As shown in Figure 3.5, for each of the 10 patient bays at TRU, three camera views were captured and displayed at the distant command center. The first camera had fixed lenses and was mounted from the ceiling about 10 feet away from the bay to provide overall view of the bay. The second camera was also mounted from the ceiling but had remotely controllable zoom lenses with pan and tilt control. This camera allowed the distant leader to look closely at the patient's wounds and other details. The third camera was mounted on a head-harness, to be worn by one of the care providers. Coupled with the two-way audio communication system deployed, this head-mounted camera allowed better remote visual access and as well as wearer's point of view. The video from the battery powered, head-mounted camera was transmitted wirelessly.

To facilitate data collection, audio-video recordings were made on all audio-video communication and on patient vital signs as displayed on the bedside patient monitors (Figure 3.6). Additionally, the injury status of the patients in all studied cases was extracted from the hospital database. Information related to the identity of the patient was never collected.

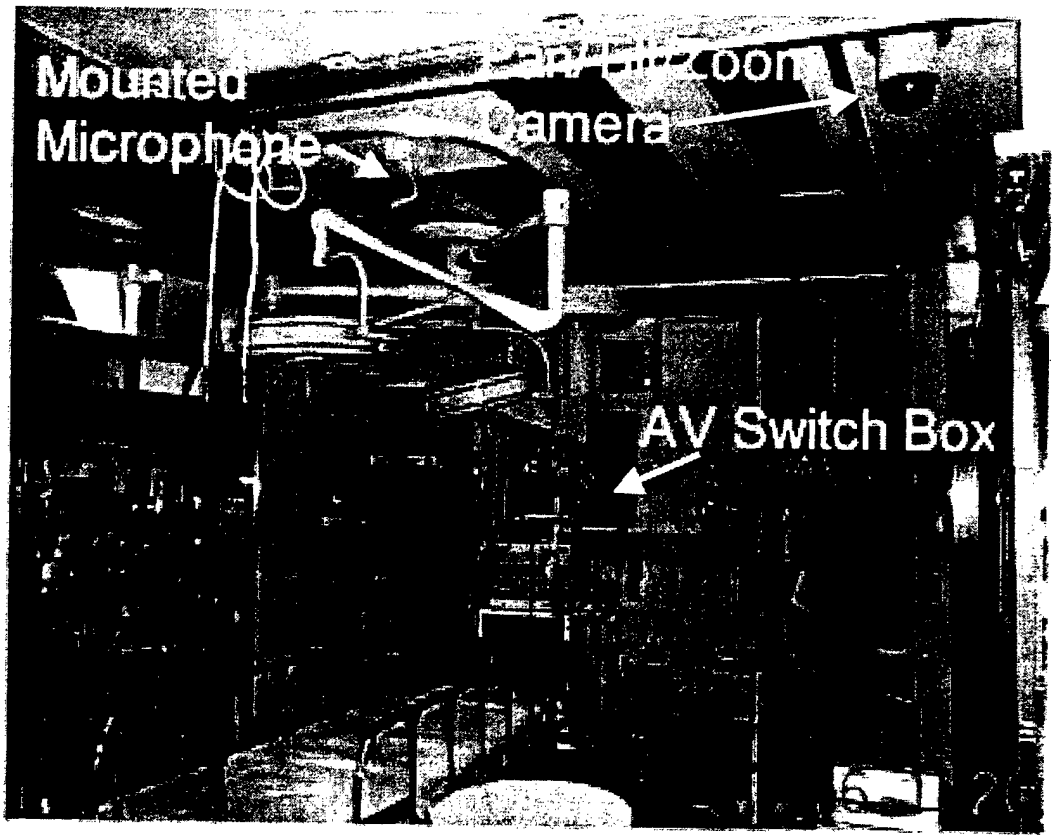


Figure 3.1: *Audio-video data acquisition installation at a trauma center.*

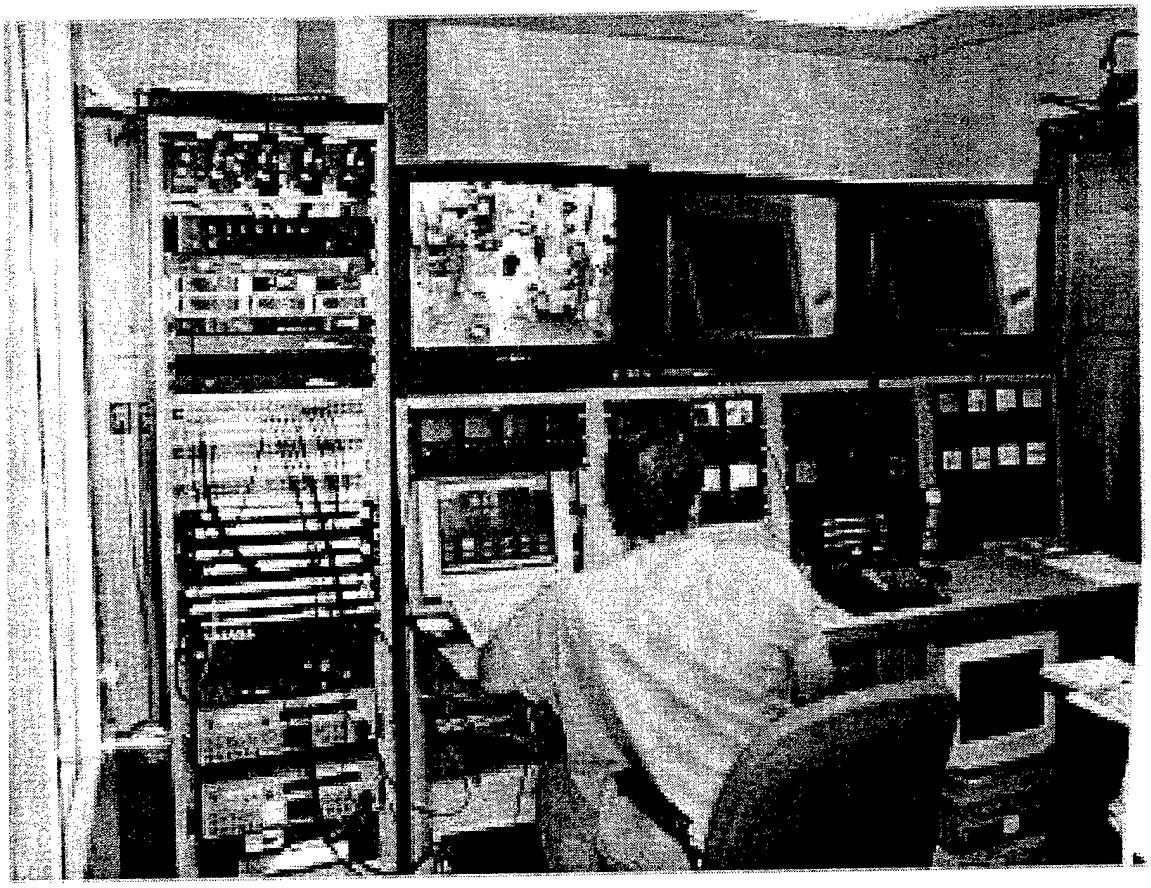


Figure 3.2: *Telecontrol center. The instrument rack on the left contains a time-code generator for synchronizing recordings across different recording devices (top), a patch-panel to allow flexible configuration of input and output devices (middle), and video recording decks using VHS format videotape (bottom). In the control console desk, the computer screen is a touch-screen controller for switching the video sources displayed and recorded between different patient-care areas on the large monitors (top).*

Figure 3.3: *Bone-conducting infrared audio communication system. The operator wears a headset with a boom microphone, and a bone-conducting ear-piece that is near to but does not cover the ear. The operator controls communication with a clip-on control-box worn at the belt-line (insert).*

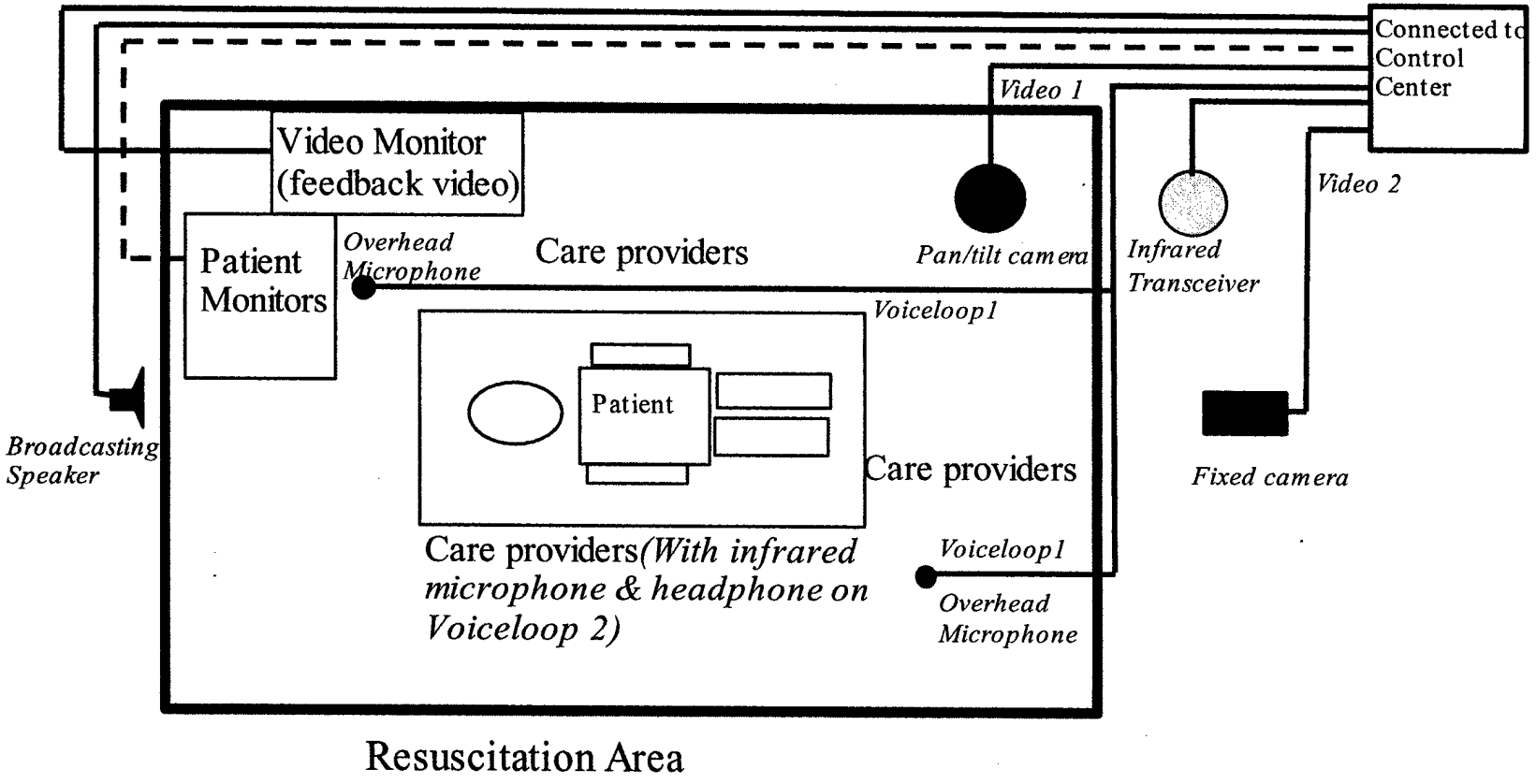


Figure 3.4: *Connection schematics of the test bed for distributed team research.*

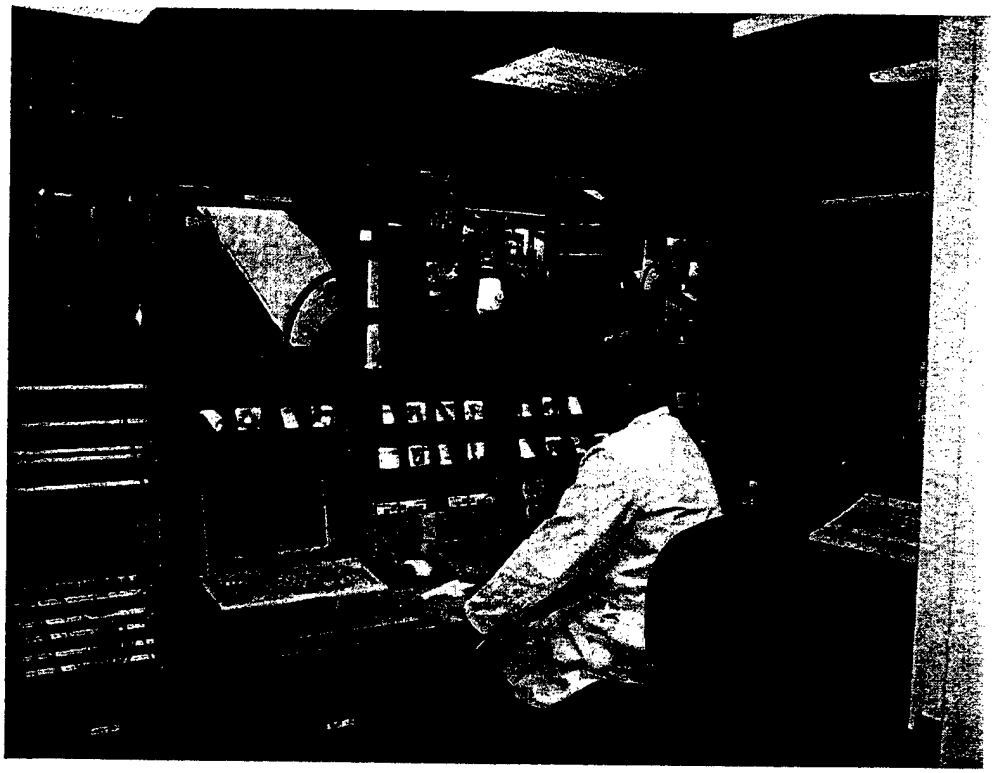
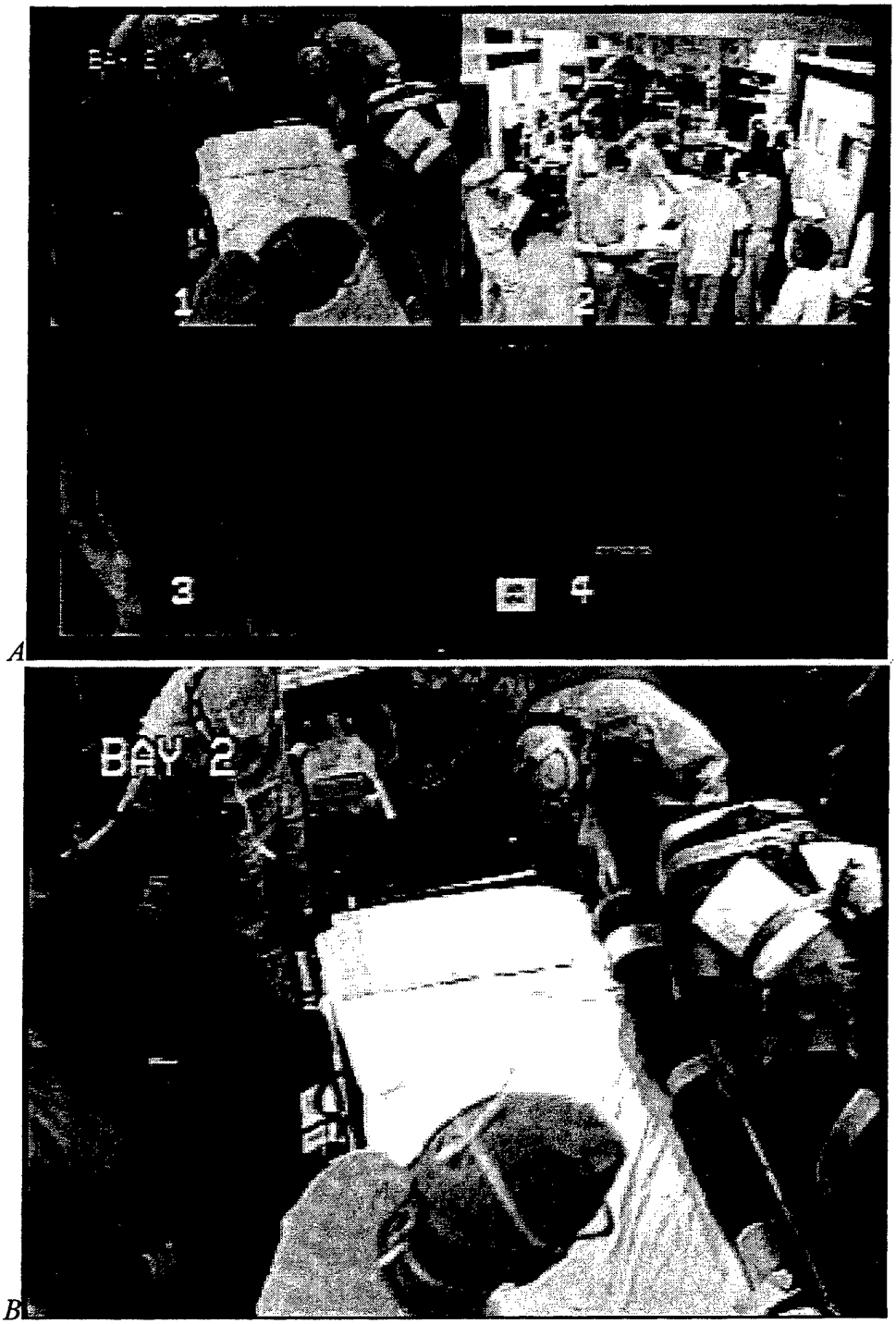


Figure 3.5: *Configuration of distant leadership experiment setup. Shown here is the workstation for the distant leader. The distant leader had visual access to the remote team through three camera views. One of the camera views was controllable by a pan-tilt-zoom controller; another was from a tetherless head-mounted camera. The distant leader also had two-way audio communication through an infra-red wireless head-phone system.*



A

B

Figure 3.6A and B: *Sample video images for audio-video recordings. Shown in (A) are combined views from four different sources. Upper-left: the pan-tilt-zoom camera looking down the patient's gurney; Upper-right: an overview camera looking into the patient resuscitation bay; Lower-right: the screen capture of the patient monitor; and Lower-left: the view from head-mounted camera, displaying here a care provider's view while examining the gurney near the patient's head. (B) Full-sized image of the pan-tilt-zoom camera.*

Chapter 4. Study I: Team Leadership in Trauma – An Observational and Interview Study

As reviewed in Chapter 2, team leadership as a phenomenon is poorly understood. Basic questions related to the phenomenon, such as what is team leadership, are not well answered. To offer new insights for further theory development and subsequent hypothesis-testing research, foundational research is needed. The purpose of Study I was to fill this void through a qualitative study of action teams and their leaders. Study I used qualitative data to explore the role of team leaders in shock trauma action teams. Qualitative research is especially suited for the study of leadership due to the complexity of the topic (Conger, 1998; Parry, 1998). Indeed, leadership has traditionally been studied with a quantitative methodology and analysis of data. This lack of a qualitative focus has been cited as one of the main reasons for a lack of richness and impact of many leadership theories (Conger, 1998; Parry, 1998). Further, it has been noted that "qualitative research is, in reality, the methodology of choice for topics as contextually rich as leadership" (Conger, 1998, p. 107). Thus, because of the lack of extensive research on the contextually rich topic of team leadership, a qualitative approach was chosen in order to attempt to obtain a more detailed understanding of team leaders in action teams.

Method

Several different data collection methods were used in Study I: observation, interviews, and review of archival data such as videos of patient care in real trauma treatment. Over a 15 month period, over 225 hours were spent at observing the treatment of approximately 175 different patients in the trauma resuscitation unit (TRU) of the studied trauma center (Chapter 3). During observation, a combination of notetaking and observer self voice annotating was used. Voice annotation method was used to improve the ability to write down rapid events occurring during trauma patient resuscitation. After each observation period, the notes were transcribed by the researchers. During observations, the researchers often spoke informally to many of the TRU staff members in order to gain an understanding of medical procedures and of TRU norms and routines.

In-depth interviews were conducted with a cross sample of the TRU members. Specifically, ten interviews were conducted with at least one member from almost every position composing a usual trauma team. These positions include attending surgeon, attending anesthesiologist, surgical resident, emergency medical resident, medical student, nurse, and trauma technician. During the interviews, open-ended, in-depth questions were asked about several topics including: the respondent's background and general reactions to working in the TRU; the nature and function of team leadership during the treatment of patients in the TRU; team processes such as conflict, cooperation, and shared mental models; and dimensions of team performance in treating patients in the TRU. The interviews lasted between 30 to 90 minutes. Similar to Waldman et al. (1998), we took several steps to increase the accuracy and reliability of the data collected during the interviews. Specifically, these steps included a neutral probing of answers, promises of confidentiality, and the use of an informed consent briefly detailing the study. All interviews were audiotaped and later transcribed verbatim. Most interviews were transcribed by a third clerical party which helps to facilitate a complete and unbiased transcription of the interview data (Eisenhardt, 1989).

The third method in Study I was reviewing archival data. The archival data included the training guide used for new TRU nurses, documents describing the development and history of the TRU, and existing videotapes of patient treatment in the TRU. Further, we solicited feedback from subject matter experts of trauma teams (i.e., surgeons, anesthesiologists, nurses) and from subject matter experts of leadership in order to protect against our own biases and assumptions influencing data collection.

Results

Who is the Leader of the Team?

As mentioned previously, a notable omission of past team leadership theories is the failure to describe who is identified as the team leader and why that person is conceptualized as the team leader. For several reasons, teams within the TRU that we studied provide an interesting setting in which to examine the identity of team leaders. The attending surgeon within each team is designated as the nominal team leader through an established national protocol for the treatment of trauma patients. But, TRU teams are highly differentiated horizontally; members of the team differ in job role and have different backgrounds in training (e.g., surgery, anesthesia, nursing, radiology). Finally, teams members differ vertically as members of the team have different status due to job title and/or experience. Thus, an attending surgeon has greater status than a surgical fellow, a surgical fellow has greater status than a surgical resident, etc. These factors suggest that the team leader will invariably be the attending surgeon: the attending surgeon is designated as the team leader by protocol, is likely to have the most experience at the TRU, and has the highest status. Yet, in many instances, the attending surgeon is by no means the obvious and clear leader of the team.

Through Study I, we found that a number of different team members may be considered the leader of the team: the attending surgeon, the attending anesthesiologist, the surgical fellow, the resident in charge of the patient, and/or the nurse. For example, one open-ended question during interview asked "When you think of the leader in the bay, who do you think of?" Many respondents listed more than one position and each of the positions from attending surgeon to the nurse was listed at least once. This finding mirrors our interview results; interviewees differed in their identification of the team leader and many interviewees reported that – across patient admissions – individuals within different positions may play the primary leadership role within the team.

What determines who will emerge, within a given team and given patient admission, as the leader of the team? By professional and local norms, the attending surgeon has the right – the legitimate power (French and Raven, 1959) – to actively assume the role of team leader. Whether the attending surgeon chooses to assume this the role may thus reflect his/her personality, his/her values, and the task characteristics (here, the nature of the patient's injury). Consider the example of one attending surgeon within the TRU. We observed, and heard in our interviews, that this surgeon – when on duty – was invariably present during each patient's treatment and always assumed the leadership role. We learned that he was very conscious of potential malpractice lawsuits. As the individual ultimately responsible for patient care, he wanted to be present and to assume the leadership role during the treatment of all patients for which he was responsible. In contrast, other attending surgeons – when on duty – were content

to intervene actively in patient care only on an "as-needed" basis, preferring to allow other, more junior team members to develop their diagnostic and leadership skills.

Our interviewees reinforced our observations regarding the variability we observed in the active leadership of the attending surgeons. For example, when asked to identify the leader of the team, one surgery resident reported:

> *Well, that depends on the attending you're working with. Some attendings like to be more hands-on than others. During my first week here, I worked with an attending who liked to do everything himself. He liked to put the lines in, he liked to do everything himself. Our attending this week is much more hands-off, you know? He may not even have gloves on. He stands back and lets us do what needs to be done and makes suggestions, but he doesn't really get too hands-on. And some are in the middle. I would say, when you have a more hands-off attending, the leader becomes the surgical fellow, at least in the severe trauma cases. In trauma cases where it's really more routine and not as critical, the resident is really the team leader.*

In a similar vein, another resident reported:

> *Whether the attending chooses to be the leader or not is more attending dependent... Attendings who like to be in control all the time will do that regardless of the severity of the cases.*

Further, a nurse commented:

> *Some are more hands on, some are hands off. Some sit back. Some are more vocal. There are attendings who put their hands on and touch the patient and others that kind of just stand back and watch the residents.*

Through our interviews and observations, we found that not only may the attending surgeon, the surgical fellow, and/or the resident assume the role of team leader, even a team member with little formal status or legitimate power may assume this role. Nurses can play an active leadership role by virtue of their expert power (French & Raven, 1959). Nurses are constants in the TRU while residents are more transitory. For example, some nurses have been working in the TRU for 13 years and have been on thousands of different resuscitation teams while most residents only spend a month in the TRU. Therefore, nurses have developed expertise in the protocols, procedures, and norms of team functioning and can use this knowledge to lead the team, typically in a subtle or covert fashion. An attending anesthesiologist whom we interviewed provided the following example:

> *If the nurse asks a resident who's in charge of the patient a question like "Can we get some sedation?" or "What sedation do you want to give?" or "How do you want to treat the pain?" the smart resident recognizes the question for the loaded gun that it is and says "What do you usually do?" That's the correct answer because the nurses have done it thousands of times. The unwary resident will say "Give them 25 of Demerol" and then the nurse will say "We don't use Demerol here" and the resident will either get in a snit about that and insist on Demerol, in which case we have a problem. Or, the resident will recognize the nurse's experience and expertise and the conversation will continue on rationally.*

These examples have helped to answer the question of who is the team leader. Specifically, the data have illustrated that a number of different people can provide leadership. Thus, the team leader is not always the individual with the most legitimate power (e.g. attending surgeon) as one might expect based on existing team leadership theories. When the attending surgeon chooses not to play an active, hands-on leadership role, other leaders are likely to emerge. Factors such as task characteristics (the severity and novelty of the patient's injuries), medical expertise, and knowledge of group and TRU norms may play an important role in the determination of who is likely to emerge as the team leader.

What Do Team Leaders Do?

One commonality among many prior team leadership theories has been the distinction between leaders either exhibiting monitoring behaviors or action oriented behaviors. Indeed, this distinction is also present with the behaviors of team leaders in the TRU. For example, an attending surgeon described the role of the leader this way:

> *The role of the leader is to supervise the residents in terms of managing the entire medical needs of the trauma patient. Supervision involves both overseeing the residents as they do their thing with the patient, plus guiding and educating them, and helping them with their decision-making. And often, the leader needs to take over the decision making if the resident is uncomfortable or is not able to proceed with the plan.*

Thus, this quote exemplifies both the monitoring or overseeing functions as well as the action behavior of taking over decision making.

In the current time sensitive TRU setting, these leadership behaviors are sometimes performed by two individuals so that both monitoring and action can take place simultaneously. Thus, for example, we often observed that one team member (e.g., the resident in charge of the patient) would actually perform key tasks (medical procedures such as the insertion of a chest tube) while, simultaneously, another team member (e.g., the attending or the fellow) would monitor the status of the patient and other external factors (obtaining x-rays, getting the proper supplies, etc.). A resident described this pattern in this way:

> *I guess there are actually kind of two leaders if you think about it. One leader will actually stand back and will not actually be doing anything, but will be calling the shots and will be saying you do this, you do that, you do that, and that happens. And then there will sort of be another lead person who is actually performing all those tasks and communicating (with the person) who's sort of standing back.*

Thus, similar to previous team leadership theories, the leader behaviors of monitoring and taking action are important in TRU teams, but within TRU teams, these behaviors may be performed simultaneously by two different leaders in the team.

In terms of leader behaviors, the interview results stressed preference of certain leadership:

> *I think the leader should make strategic decisions, delegate duties to subordinate team members, and then he should obtain feedback and wait to see the results of his decisions think that this environment should be used as a teaching environment as much as possible...I think that in order to be a successful leader in this environment, you need to provide a lot of encouragement.*

Our findings suggest that other leader behaviors, much heralded in the current leadership literature, may have negligible consequences within the TRU. Specifically, respondents reported that transformational leadership behaviors and motivating and inspiring leadership behaviors (e.g., Bass, 1996) were rare within the TRU and further that these behaviors had no impact on team effectiveness in the TRU. Within the TRU, team leaders may not need to convey an inspiring vision to team members because the work itself – saving the lives of patients who have been shot or stabbed or who have suffered a serious car crash -- is motivating enough. Indeed, in our interviews, many members of the TRU commented that the thing they liked best about working in the TRU was the work of saving people's lives.

Our interview findings regarding charismatic or transformational leadership behaviors are consistent with substitutes for leadership theory (e.g., Howell, Bowen, Dorfman, Kerr & Podsakoff, 1996). Task characteristics – here, the variability, urgency and impact of the work – can substitute for leadership. Other potential substitutes for leadership in the current setting include highly developed task and role knowledge. For example, in describing the perfect trauma team, an attending anesthesiologist explains that,

> *The perfect trauma team functions in total silence when everyone does what they are supposed to. The leader stands at the foot of the bed and just watches and integrates the information that comes back. The first words he says are "It is time to go to the operating room now."*

These findings have helped to answer the question of what team leaders do. Specifically, further support can be given to the conceptualization of past team leadership theories that leaders engage in both monitoring and action behaviors. Indeed, in the current study, leaders engaged in both of these behaviors; however, this study extends previous conceptualizations through the illustration that monitoring and action behaviors can be done simultaneously by multiple team leaders of a single team. In addition to these general behaviors, the current study also highlights specific behaviors that the team leader both performs and does not perform. Based on our observations and interviews findings, particularly effective leader behaviors include formulating a game plan, delegating tasks, teaching team members how to perform these tasks when possible given task constraints, monitoring team member performance, and providing encouragement and rewards for successful performance. Further, our findings suggest that task characteristics and expert knowledge may indeed substitute for certain leaders behaviors – particularly charismatic or transformational behaviors. Thus, our findings both reinforce existing team leadership theories and suggest new insights for further theory development and research.

What are the Results of Team Leadership?

To gain an understanding of the effects of team leadership, we began by asking interviewees how they assessed the performance of TRU teams. Not surprisingly, all interviewees emphasized patient outcomes: did the patient recover as well or better than expected, given the nature of his/her injuries? This is a measure of team *effectiveness*. Another key aspect of performance identified by interviewees was the number of "re-do's" necessary in treating the patient: how many tasks had to be done over because they were done incorrectly or inadequately the first time? A prime example was x-rays: did the patient haven't to be x-rayed a second time, because team members failed to identify all necessary x-rays the first time? This is a measure of team

efficiency. Finally, a third key dimension of effectiveness is *learning*: do team members learn new diagnostic and treatment skills as a result of their participation in patient care? A dynamic tension is obvious here. Team members are most likely to learn if they assume responsibility for tasks that are new to them, or if leaders engage in teaching new behaviors during the care of the patient. However, these behaviors may lengthen the time it takes to treat the patient, potentially slowing the patient's recovery or increasing the likelihood of "re-do's."

Leader behaviors, we observed, may have a direct impact on team effectiveness, efficiency, and learning. When expert leaders perform active, hands-on treatment of the patient, they are likely to increase the effectiveness and efficiency of patient care, while potentially decreasing the likelihood of team member learning. Conversely, when leaders engage in teaching behaviors, they augment learning but may reduce efficiency. Of course, most team leaders are careful, as some of the quotes above have suggested, to balance the extent to which they intervene directly in patient care and the extent to which they engage in teaching behavior. That is, most attendings and fellows provide more hands-on, direct leadership when the patient's injuries are serious, novel, and urgent and more teaching leadership when the patient's injuries are less serious and urgent.

A number of leader behaviors may have an indirect effect of team efficiency and effectiveness by enhancing the team's shared mental model and subsequent abilities to coordinate team member activities in treating the patient. Strategizing, or developing a game plan may facilitate a team's ability to carry out patient treatment smoothly and efficiently. Some of these leader behaviors may occur well in advance of patient care. For example, an attending anesthesiologist noted that an effective surgical fellow:

> *...has done a lot of this ahead of time. He has sat the residents all down and said "Okay, when a patient arrives; this is what you do, this is the person that is in charge, this is who talks to the patient, these are the diagnostic studies we do, and so on.*

Experience also plays a role in developing a shared mental model among team members. Teams whose members have worked together for a while are more effective than teams whose member have just begun to work together. For example, one resident commented:

> *I do (think there is a shared mental model), and I think that's a function of (a) how well you know your team members, and how long you've been working together—which in our case is starting to happen but we've only been working together, this team all together, for two weeks—and, (b) the experience of the people on the team. The more experienced members of the teams will be able to read each other's minds because they've been through that scenario a hundred times.*

Leader personality or style may also be influential, as one anesthesiologist suggested:

> *I found that as an anesthesia resident, you go through a certain number of tests starting a case. Every big case, there is a bunch of stuff you have to do; you have to put some lines in, you have to connect a bunch of monitors, you have to push drugs, intubate, and all sorts of stuff—a certain amount of work for two people. With some attendings, it would be wonderful. Every time I would lean left, he would lean right; I would pick up the mask and he would give the drugs. In other attendings, it was exactly the opposite, we were always reaching for the same thing at the same time...some of that was clearly personality driven and how you think, some of it is clearly practice.*

In sum, our findings suggest that, in this setting, the standard performance outcomes of effectiveness and efficiency are broadened to include team member learning as well. Further, our results suggest that leaders may have a direct impact on team performance or an impact mediated through the team's shared mental models. Thus, our findings lend support to both direct effect team leadership models as well as mediated team leadership models.

Discussion

The purpose of Study I was to expand existing conceptualizations of team leadership theory. In order to accomplish this end, several theories of team leadership were reviewed. Comparison and analyses of these theories revealed three key questions for further research: (1) who is the team leader, (2) what does the team leader do, and (3) what are the results of team leadership?

Extending existing conceptualizations of the identity of the team leader, our findings suggest that a number of individuals may play a leadership role within the action teams that we studied. The team member with the greatest expert and legitimate authority – here, the attending surgeon – may assume the primary leadership role, if he/she is present to do so and he/she chooses to do so. At least one attending surgeon endeavored always to be present and always to assume an active, hands-on leadership role. Other attendings were not always present. Moreover, these attendings often chose to recede from direct leadership – to perform a monitoring leadership function, while other members of the team assumed more direct, hands-on leadership. Finally, even low status team members (i.e., nurses) sometimes assumed a covert, but widely respected leadership role when their expertise exceeded the expertise of higher status team members (i.e., residents).

Our findings thus suggest a complex and nuanced view of leadership within an action team. Leadership may change dramatically in at least two ways from task to task (that is, from patient to patient). First, the identity or identities of the leader(s) may vary from task to task. And second, the leadership behaviors exhibited may vary dramatically from task to task. Thus, leadership may not be the province of any single individual, nor may a given leadership style always characterize a given leader. In sum, a variety of factors may influence the leadership observed within a team, including team member expert power, team member legitimate power, team member personality and values, team composition, and team task characteristics (e.g., severity of the patient's injuries). Within TRU action teams, one cannot study "the team leader." There is no single team leader over time and tasks.

Our findings regarding leader behaviors offer some support for existing conceptualizations of what leaders do. TRU leaders performed both monitoring functions and action behaviors. But, consistent with our comments above, we found that different individuals may simultaneously perform these roles. Extending several models of team leadership (and largely consistent with Kozlowski et al.'s model), we identified five leader behaviors as particularly instrumental to team performance: problem solving, strategizing, teaching, monitoring, and providing contingent rewards. Our findings thus suggest that the ideal TRU team leader is rather like a coach, formulating a game plan of patient treatment through problem solving and strategizing, instructing team members how to perform the tasks necessary to carry out this game plan, monitoring team execution of the plan, and rewarding the team for a good job with contingent rewards. This analogy – team leadership as coaching – seems particularly

powerful and apt in an era in which organizational change is more prevalent than ever and intellectual capital is an organization's greatest competitive advantage.

Our findings regarding the nature of team performance and the potential effects of team leadership on team performance are also, not surprisingly, in keeping with the growing interest in organizational intellectual capital. Within the TRU, team performance is defined not only in terms of effectiveness and efficiency, but also in terms of learning – that is, building intellectual capital. Further, while our findings suggest that team leaders may have an important direct effect on team performance especially when the task (patient care) is urgent, our findings also highlight the indirect effects of leadership on team performance. That is, team leaders may indirectly enhance team performance by fostering a shared mental model among team members – a team-level intellectual, or knowledge, asset. The effects of team leadership on team member learning and the development of shared mental models have, to our knowledge, been very little studied. These strike us as compelling topics for future research.

Our findings must, of course, be considered very preliminary. Our use of multiple research methods in this exploratory study may help to compensate for the inherent limitations of each method alone, but clearly further exploratory and hypothesis-testing research is needed. It is not clear to what extent are findings will generalize to other action teams or to teams of other kinds. Still, our findings lend support to existing models of team leadership, while suggesting new opportunities for theory-building and research regarding the identity of team leaders across time and tasks, the behaviors that leaders perform, and the range of team outcomes that team leaders may influence.

Chapter 5. Study II: A Review of Archival Videotaped Team performance

To explore the manifestation of team leadership in intense situations, this study was to leverage an existing library of audio-video recordings of real-life team performance during trauma resuscitation.

Materials and Methods

In a previous project, a video library of 120 cases of real trauma patient resuscitation was established. Aside from video and audio recordings, medical records (e.g. patient admission records, anesthetic records, discharge summary, vital signs, and blood chemistry) were also collected. A majority of these cases were reviewed by subject matter experts, both neutral (i.e. not in the recorded cases) and participant (i.e. in the recorded cases). The video tape cases contained in the video library had been used in the investigation of decision making under stress (e.g. Xiao, Mackenzie, & LOTAS Group, 1995 on fixation errors) and team coordination (e.g. Xiao, Mackenzie, Patey & LOTAS Group, 1998 on coordination breakdowns).

While reviewing the cases from the library, subject matter experts were asked to identify case segments with both extremely positive leadership and extreme negative leadership. A set of prototypical scenarios was compiled where leadership was either needed but not fulfilled or was judged to be critical to team performance. The purpose of the video analysis here was primarily descriptive, with the objective of generating a list of functions performed by leaders and a list of task situations in which leadership would be critical.

Results

Through an iterative process, seven types of leadership scenarios were extracted:

1. Protocol-driven, minimum leadership role is anticipated.
In this type of scenarios, the activities of the team were driven primarily by established protocols or standard operating procedures, due to the familiarity of team members with the tasks at hand and to the situation confronted. Many cases contained such scenarios, where little inter-personal communication was observed.

A typical video record showed the junior team member asking the patient a standard list of questions, "What is your name?", "What happened?", "Where does it hurt?" followed by a more in-depth history, "Have you ever been in the hospital before- What for?" etc. A physical exam is conducted while the trauma nurse puts on physiological monitoring equipment and cycles a blood pressure device. The anesthesiologist places a probe on the patient's finger to measure oxygen saturation in the blood and listens to the patient's chest and assesses the airway. Each medical and nursing team member goes about their task, while listening to responses of the patient to questions posed by the junior team member. The surgical team leader was often seated out of view but could be heard asking an occasional question or making a brief appearance to

examine the patient. Tasks were achieved in a sequential manner guided by the Advanced Trauma Life Support Protocol.

2. Hetero-hierarchical teams, with conflicting goals.
As described earlier, a trauma resuscitation team consists of multi-disciplinary team members. Although the overarching goal for each member is the same, there may be differences in perspectives. As well, it may also occur that a junior member in one discipline may exert leadership over those senior in experience but in a different discipline. In several cases, for example, the anesthesiologist had different opinions in terms of plans and argued overtly with a surgical member.

An example of hetero-hierarchical leadership is that the expertise for airway management resides with the anesthesiologist, not the surgeon team leader. Among the task of airway management, the surgical team will perform a supportive role for the anesthesiologist (stabilize the neck, apply pressure on the voice box, etc). A dispute occurred in one case between the anesthesiology attending and a neurosurgical resident about the need to paralyze a patient who was breathing inadequately. The course of action taken by the anesthesiologist was to paralyze the patient with a long acting drug because he knew that the patient was about to be taken for a radiological exam where he would be moved back and forth. Such movement if the patient was not paralyzed would cause coughing and raise the pressure in the brain. The neurosurgical resident wanted the patient not paralyzed so that he could perform a neurological exam. The more experienced anesthesiologist knew that the neurosurgical resident would not, in fact, get any useful knowledge from the neurological exam in the radiology suite because of limited patient access. The argument was resolved by the surgical attending, telling the neurosurgical resident that the team needed to go immediately to the head scanner.

3. Failure to assert leadership.
Trauma teams often have layered responsibilities. A team member may function under the supervision and guidance of another. A prototypical example would be a physician under training (e.g. a resident physician) performing a medical procedure under the supervision of an experienced physician (e.g. an attending physician). In the type of scenarios of "failure to assert leadership", we observed that the supervising member did not provide guidance. In one case, one member acted as if to sending out a message to the supervising member "I will ask help if I need to". The supervising member did not correct a serious judgment error by the supervised member.

In one video record, the attending anesthesiologist failed to exert leadership over a nurse anesthetist he was supervising. The nurse anesthetist had been at the institution several years longer than the attending anesthesiologist who appeared, under social pressure, not to intervene when the nurse anesthetist was struggling to inset a tracheal tube. The tracheal tube was misplaced in the esophagus and the attending anesthesiologist made several indirect attempts to ascertain the status of the airway- "Do you think you are in?" Then because of uncertainty about the patient status, the attending anesthesiologist became fixated on coping with a patient monitor that was not providing data, he switched it off and on to rest the controls, but failed to ask the nurse anesthetist to step aside while he checked for himself the position of the tube by repeating direct visualization by laryngoscope or by using available equipment to check for exhaled CO2

from the misplaced tube. The anesthesiologist attending leader of the airway management task failed to communicate directly or take corrective actions unilaterally.

4. Contrasting leadership styles.
Several cases provided contrasting leadership styles. The most striking contrast was observed in a case when an inexperienced team leader failed to convince another member through exerting authoritative decisions, whereas an experience team leader later on in the case presented rationales for decisions and used first name to talk with the dissenting team member.

The benefits of one leadership style over another were exemplified by one video record in which the attending anesthesiologist and the junior surgical attending became argumentative over the need to anesthetize and tracheally intubate a patient who had no obvious injuries, was intoxicated and required to have blood drawn. The anesthesiologist wanted to talk to the patient and sedate him. The surgeon became quite verbally abusive to the anesthesiologist and no resolution seemed possible until a more senior surgical attending arrived. The senior surgeon called the anesthesiologist by his first name, explained the reason why he would like the patient anesthetized and made some humorous remarks that appeared to lighten up the previously tense atmosphere. The junior attending had never addressed the anesthesiologist by name, referring to him in the following manner, "Anesthesia, I want you to intubate this man."

5. Poor task delegation and crowd control.
At the first few minutes of a trauma patient admission, many people were observed to crowd around the patient in several cases. How to delegate tasks and organize a team became a salient feature of leadership. Some leaders arranged a tentative task delegation before the patient arrived and then called out plans and steps after the patient's arrival. Such strategy seemed to reduce confusion in the first few minutes of the patient's arrival.

With a priority one (severe injury) patient admission, one leader had all the team members standing round the patient gurney discussing which task each would accomplish from the limited patient history and mechanism of injury, he described the things the team should look for. He had the team gowned and one member in sterile gown and gloves, ready to perform emergency invasive procedures. One video record showed quite the reverse situation with many non-participant onlookers, excessive noise, inappropriate behavior and poor tem coordination.

6. Task urgency demanded leadership but it was not provided.
When there is confusion in terms of goals and situation assessment, leadership may mean the difference between a chaotic team process and an orderly process. In several cases, when task urgency was high, the team leadership seemed to be absent. In one case, for example, the patient needed immediate cardio-pulmonary resuscitation (CRP) upon arrival. While the CPR was in progress, it was important for the team to assess the success of CPR effort periodically. In this case, the team leader was visibly absent while concentrating on a sub-task and letting the rest of the team on "auto-pilot".

The surgical team leader was not present when the anesthesia team inserted a trachea tube into the airway and found blood. The surgeon then appeared and cardiopulmonary resuscitation began because the anesthesiologist said he could not feel a pulse in the neck. The surgeon began

assisting a junior member of the team inserting an IV and appeared totally engrossed in this activity without monitoring of the progress of CPR or any of the other activities.

7. Ruling out good options.
The immediate goal of a trauma team at the patient's arrival is to assess and stabilize the patient. The task urgency and pressure to act are usually directly linked to the severity of injury. However, when the expected outcome is very poor, the urgency and action pressure may in fact be reduced. In one case, the patient was reported to have suffered severe injury. Upon arrival, the patient's condition was clearly grim. The team was then focusing on assessing the feasibility of any viable options.

One video record showed progression of the patient from the resuscitation area to the operating room (both locations were equipped for video recording). Initially there was a lot of effort directed towards stabilizing the patient sufficiently to allow radiological investigation to detect the site of bleeding. However, the attending surgeon made the announcement "he's going down the tubes" – "we're going to the OR". He proceeded to make a phone call while the rest of the team tried to make preparations. The patient was dragged into the OR without the anesthesia or nursing team being adequately prepared. After setting up in the operating room, it became apparent that the outcome of death was inevitable. The surgeon leader persisted in an apparent belief that the patient could be saved, but it was clear that this unilateral decision of the benefits of surgery were not shared by the rest of the team.

Discussions

The review of the selected cases in the video library has resulted in interesting findings. One of which is on the role of leadership in highly trained task situations. We found in some of the recorded videotaped cases in which division of labor had in some cases impeded the team leader from thinking strategically and goal-oriented. There seemed to be a tendency for the observed team members to be on "autopilot" in carrying out highly trained tasks, while critical decisions were delayed.

We found that with perhaps the majority of video records the leader exerted minimal authority during trauma patient admission because the diagnosis and treatment appeared to be routine. There was little overt cognitive effort required by the team members to follow a prototypical series of tasks, such as those outlined in Advanced Trauma Life Support training manuals. In addition in these patients there was a lack of task urgency as the initial exam showed, to the leader's experienced eye, that the patient was not in any immediate danger from a life-threatening event. The terminology used by the attending staff of "eye balling" the patient, reflected this rapid synthesis of patient history (obtained in abbreviated form before patient arrival) and clinical exam by the experienced leader. In those patient admissions these leaders described their style as "hands-off". By this they mean that they are willing to let the less experienced team members proceed along their chosen pathway without formal input by their leader. In actuality, the leader will closely watch the team perform the initial assessment (the ABC's, Airway Breathing Circulation) and insure that they do not omit anything in the history and physical exam. When it comes to be time to order radiological exams or laboratory tests, the leader may question why certain of these exams or tests are being requested. The response to such a question allows the leader to determine whether the team members are considering the

same differential diagnosis as the leader. In performing teams in this low priority patient management one may find a team member summarizing the team's findings and spontaneously providing the leader with a rationale for the blood test and radiological exams requested. Alternatively, the leader may watch the initial management and depart to do other tasks with a comment like 'let me know what you find'.

Task urgency seemed to have a significant impact on the leader if the initial assessment revealed a patient in hemorrhagic shock (pale, clammy skin, high heart rate, anxious, low blood pressure) with obvious evidence of bleeding, then the leader would often provide explicit communications about task priorities and may specifically allocate duties to each team member e.g., to the anesthesiologist, "let's intubate", to the nurse-"repeat that blood pressure", to the surgery fellow or senior resident, "you get a subclavian (emergency IV access) and you see if you can get an A-line" (confirming reading of arterial pressure- difficult to insert when blood pressure low). "You put in a Foley catheter" (to drain urine from the bladder to detect bleeding and monitor kidney function). These proactive efforts demonstrate leadership, promote team coordination, and enable multiple different diagnoses to be tested simultaneously. We have video records of poor leadership in similar clinical circumstances where the team becomes focused on one task (e.g., placing a difficult A-line) to the detriment of the total patient management or the team leader told the anesthesiologist to intubate the patient when in reality the patient was oxygenating and ventilating well and there were higher priority tasks that needed completion. Poor leadership was easily recognized in video records when numerous people crowded around the patient there was a lot of extraneous chatter, very few tasks being achieved, and there was little overt monitoring of patient physiological data. No one in the team conducts a systematic history or physical exam, there are many interruptions and several people take parts of the patient history or examine one system e.g., put a stethoscope on the chest to listen to breath sound. There is one coherent plan developed and no reassessment of the situation.

Another way that video records identify leadership characteristics was during patient admissions where there was a combination of task urgency and uncertainty. In this set of circumstances, the potential differential diagnosis is very large, and yet there was an urgent need for decisions to be made and actions to be taken. The strong leader defined a specific pathway and often participated in "hands on" care with the rest of the team so that the tasks could be achieved expeditiously and the results of interventions could be rapidly assessed. The use of explicit communications include both verbal interjections (often incomplete sentences and 'jargon' was used) and gestures (motioning to the anesthesiologist- using a simulated laryngoscope and tracheal tube insertion movement acknowledged from the anesthesiologist). This "hands on" approach minimized barriers to communications among the team and help the workspace become the communication medium through with the team members coordinated their activities with those of the leader.

In similar clinical circumstances of task urgency and uncertainty, a weak leader did not exert authority, did not participate in "hands on" care often asked irrelevant questions or became focused on one aspect of the patient's problem and ...for that problem rather than considering all the potential problems, the weak leader sometimes took short cuts, but would fail to back track and reconsider the omitted steps. There was often a lot of talking back and forth between the weak leader and team members without a chain of expertise being established. The weak leader

might leave the team completely to go and consult with a colleague and generally these leaders seemed unaware of the strengths within their own team. In uncertain and urgent situations, a strong leader would consult with the experienced anesthesiologist and trauma nurse, whereas the weak leader would leave the scene and consult in private.

The general objective of the decision-making and leadership in uncertain and urgent circumstances was to narrow down the differential diagnosis as rapidly as possible. Non-viable options should be ruled out as soon possible by testing specific interventions. For example, in one video record, the patient has covert bleeding (recorded before the advent of the focused abdominal scan for ... (FAST) scan) and the team is unaware of the site and extent of the problem. Rapid fluid administration is used to determine if the patient will stabilized so that time can be spent on obtaining a more definitive diagnosis, rather than rushing blindly into the operating room in search of the source of bleeding. Interpretation of data and re-thinking out the plan is also a measure of the efficiency of leadership. Contingency planning and the ability to deal with the unexpected was also an indicator of leadership strength e.g., a two minute estimated time of arrival was announced for one video recorded patient admission identified as a gunshot wound to the head the patient on arrival was found to be two years old and needed an entirely set of instruments to manage the airway, catheter to insert IV and a different team of pediatric trauma experts. The leadership coped with this unexpected event (all children are referred to another hospital by triage protocol, but this event occurred in close proximity to the hospital) reasonably well, mostly because of contingency planning by the anesthesiology personnel who had available a completely equipped pediatric airway management box that enabled the first step in patient stabilization to be achieved while other team members and resources were gathered.

In summary a wide variety of leadership styles were video recorded in this library that was obtained to identify team performance and decision making under stress. Although the original video records were centered on the anesthesiology team, the actions of the surgical and nursing members were so closely integrated that it was possible to draw conclusions about strong and weak leadership. The differentiation among strong and weak leaders was most apparent with multi-tasking (e.g., multiple simultaneous decisions on one individual patient or multiple concurrent patient admissions) when there was uncertainty and task urgency. Time critical decision-making, with reassessment of skipped task sequencing in history and physical exam, proactive planning, cooping with the unexpected, and cognitive processing in dynamic situations were hallmarks of strong leadership.

Based on the review of the video library, a tentative list of leadership functions was suggested: planning, goal setting, personnel structuring, decision making, building shared mental models, setting priorities, and task distribution/delegation. A list of variables characterizing leadership situations was also proposed: task urgency, uncertainty, risk, workload, and conflict in priorities, in resources, in decisions, in assessment, and in goals. The review provided insight for designing experiments planned for this project.

Chapter 6. Study III: Survey Study of Leadership Behaviors

To help identify the team leader behaviors that were of greatest impact and importance during a team's initial treatment of a trauma patient, we administered surveys measuring the *frequency* and *impact* of several different leaders behaviors. This survey was administered as a supplement to our qualitative methods, not as an attempt to gather data for hypothesis-testing research.

Method

This survey consisted of 59 items of leader behaviors representing 19 constructs drawn from the Multifactor Leadership Questionnaire (MLQ) (Avolio, Bass, & Jung, 1995), the Managerial Practices Survey (MPS) (Yukl, 1991), and from items developed specifically for the TRU setting by the researchers. Responses to each of the questions were on a five point Likert scale. In addition, the survey contained several open-ended questions asking whom the participants perceived as the team leader during resuscitation; what effective leadership looked like; and what ineffective leadership looked like.

To assess the frequency of the leader behaviors, we asked respondents to rate "how typically specific leader behaviors are during the initial treatment of patients in the bay [the Trauma Resuscitation Unit]." Respondents rated the frequency of leader behaviors on a 5-point scale where 1 = "Not at all common; I rarely observed this leader behavior during the past several weeks" and 5 = "Extremely common; I usually observed this leader behavior during the past several weeks."

To assess the impact of leader behaviors, we asked respondents to rate "the impact that specific leader behaviors have on the quality and effectiveness of the crew's initial treatment of patients in the bay." Respondents rated the impact of leader behaviors on a 5-point scale where 1 = "A negative impact," 2 = "No impact," 3 = "A slightly positive impact," 4 = "A moderately positive impact," and 5 = "A very positive impact."

The survey included 10 items from the MLQ, measuring *transformational leadership* (e.g. "Talk enthusiastically about what needs to be accomplished"), *contingent reward leadership* (e.g., "Express satisfaction with members of the crew when they do their job well"), *management by exception* (e.g., "Tell members of the crew what they have done wrong rather than what they have done right"), and *laissez-faire leadership* (e.g. "Avoid making decisions"), respectively. The survey included 24 items from the MPS, measuring *planning and organizing* (e.g., " Plan in detail how to accomplish a major task or project (e.g., identify necessary action steps, when each should be done, and who should do it"), *monitoring* (e.g., "Monitor the work of crew members"), and *recognizing* (e.g., "Express personal appreciation for crew members who display special effort"), among other leadership behaviors. Finally, we included several survey items to measure leader behaviors that we observed, and interviewees described, in the TRU. These behaviors included *strategizing* (e.g., "Set goals and priorities for treating the patient"), *remaining calm and composed* (e.g., "Be composed and unflappable"), *teaching* (e.g., "Teach one or more crew members how to perform a task"), *monitoring* (e.g., "Monitor crew members'

actions to be sure that the patient receives appropriate care"), and *hands-on leadership* (e.g., "Actively participate in treating the patient").

We administered surveys measuring the frequency and impact of several different types of leadership behaviors to 35 members of the TRU. Ten TRU members completed the survey identifying the frequency of the behaviors, ten TRU members completed the survey identifying the impact of the behaviors, and 15 TRU members completed both the frequency and impact of the behaviors.

Data were analyzed following the categorization strategies suggested by Maxwell (1998). Specifically, coding and thematic analysis of the observations, interviews, and archival data were used to facilitate comparison and generate themes and conclusions. Also, consistent with Maxwell (1998), several steps were taken in order to minimize threats to validity. First, triangulation was used through the implementation of several different types of methods: observation, interview, archival data, and a survey. Specifically, triangulation "reduces the risk of systematic distortions inherent in the use of only one method, because no single method is completely free from all possible validity threats" (Maxwell, 1998, p. 93).

Results

We analyzed the survey data by calculating an impact by frequency matrix. That is, we sorted the survey items, based on the survey responses, into nine categories reflecting high, medium, or low frequency and high, medium, or low positive impact, respectively. On the basis of the matrix we identified the five leadership behaviors of greatest frequency and most positive impact in the TRU (Figure 6.1).

Based on the scaling, we selected six dimensions for further analysis in our subsequent research in the TRU. First, we selected the three leader behaviors that respondents rated as highest in frequency and most positive in impact. They were:

1. *Providing strategic direction* (scales reflecting this leader behavior included our own measure of strategizing, the MPS measure of problem solving, and the MPS measure of planning and organizing);
2. *Remaining calm and composed* (captured in our scale measuring this leader behavior); and
3. *Monitoring* (scales reflecting this leader behavior included our own measure of monitoring, as well as the MPS measure of this leader behavior).

We also selected two leader behaviors that were rated as less frequent but of substantial positive impact. The two behaviors were

4. *Teaching* (captured in our scale measuring this leader behavior); and
5. *Praising effective performance* (scales reflecting this leader behavior included the MPS measures of recognizing and supporting and the MLQ measure of contingent reward leadership).

Finally, we selected one behavior that was rated as quite frequent but of moderate positive impact:

6. *Hands-on leadership* (captured in our scale measuring this leader behavior).
   We included this leader behavior as it was particularly beneficial in differentiating the

behaviors displayed by differing leaders, in differing conditions. Attendings, for example, tended to display less hands-on leadership than surgical fellows and residents. Further, in the remote leadership condition of the experimental study, attendings – of course – could provide absolutely no hands-on leadership.

Discussion

This survey study was an extension to the earlier studies (Studies I and II) for understanding team leadership in highly specialized and trained teams. In these teams, as reported in Studies I and II, the traditional bipolar positions of team leader and followers do not describe the complex and intricate leadership behavior, as multiple people in a team may provide leadership functions while leadership functions themselves can be multi-faceted. During performance in intense situations, several types of functions may not be salient, such as team development. The survey study identified frequent and high impact leadership behaviors. The findings provided a basis for future studies, including Study IV, the field experiment on distant leadership.

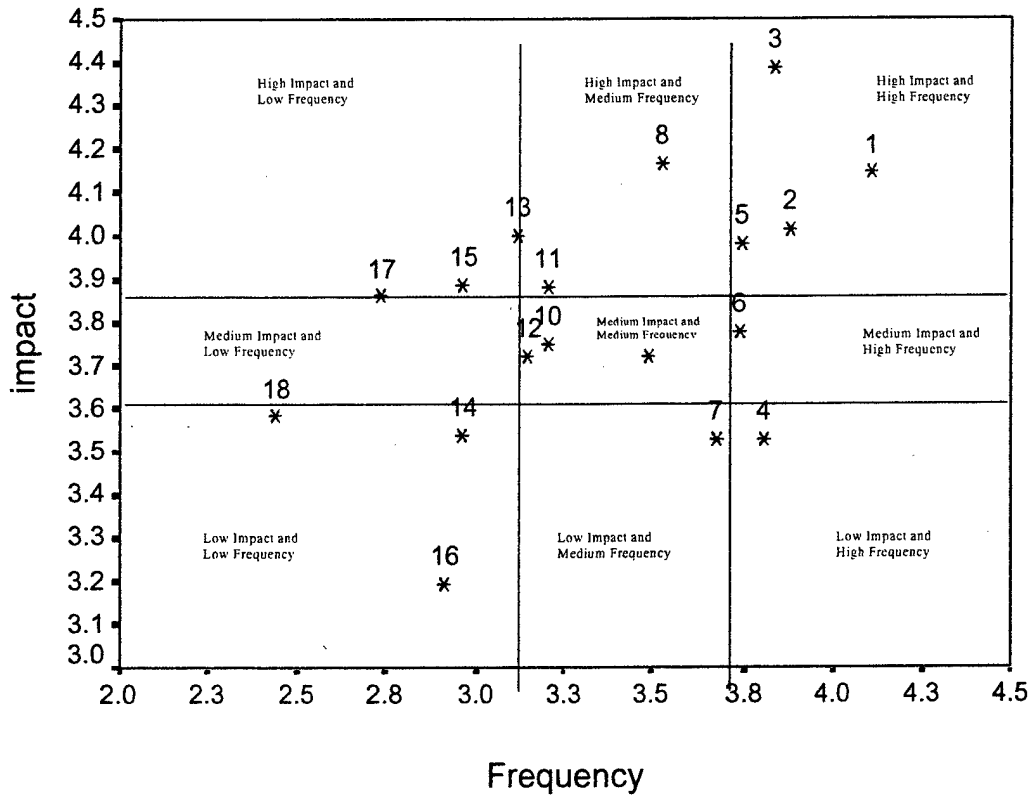


Figure 6.1: *Scaling of the 20 dimensions of leadership, on impact and frequency. The scaling space has been divided into nine sections, reflecting high, medium and low levels of impact and frequency.*

1. *Strategic direction (own construct scale)*
2. *Calm and composed (own construct scale)*
3. *Problem solving (MPS)*
4. *Directive behavior (own construct scale)*
5. *Monitoring (own construct scale)*
6. *Planning and Organizing (MPS)*
7. *Hands-on Leadership (own construct scale)*
8. *Monitoring (MPS*
9. *Teaching (own construct scale)*
10. *Managing conflict (MPS)*
11. *Clarifying Roles and Objectives (MPS*
12. *Transformational Leadership (MLQ)*
13. *Contingent Rewards (MLQ)*
14. *Consulting (MPS)*
15. *Recognizing (MPS)*
16. *Delegating (MPS)*
17. *Supporting (MPS)*
18. *Motivating and Inspiring (MPS)*

The following dimensions were not included because of very low scores on both frequency and impact.

19. *Management by Exception (MLQ)*
20. *Laissez-Faire (MLQ)*

MLQ = Multifactor Leadership Questionnaire (Avolio, Bass, & Jung, 1995)
MPS = Managerial Practices Survey (Yukl, 1991)

Chapter 7. Study IV (Field Experiment): Research Design

Trauma resuscitation in trauma center usually occurs in a confined space for a short period of time. It provides a natural "laboratory" for studying team leadership under stress. Study IV is a quasi-field experiment carried out in which the location of the surgical attending physician (the team leader) was manipulated between two conditions: distance (the leader in the distant command center) and local (the leader collocated with the rest of the team in the bay where the patient was). The objectives of Study IV were to study the impact of distance on team leadership and the impact of two other factors: task urgency as a stressor and team experience. These two factors varied naturally due to variations in patient injury status and relative short tenure of the trauma teams in the studied trauma center.

Human Subjects

An anticipated obstacle for Study IV was to conduct the field experiment while ensuring the welfare of the research participants and the patient. There had been a long history of conducting human subject research in the studied trauma center. Strong rapport existed between the researchers and the clinicians. Such rapport became essential in addressing the issues involved.

Extensive consultation was carried out with the management and clinicians of the trauma center to define field experiment procedures to ensure the standard care and the welfare of the patient. With the approval from The University of Maryland Institutional Review Board (see the approved consent form and approval letter in Appendices A and B), the study participants were recruited from surgical care providers (attending surgeons, surgical fellows, and surgical residents), anesthesia care providers (attending anesthesiologists, fellows, and nurse anesthetists), and trauma resuscitation unit nurses. The subject recruitment process included a number of formal and informal meetings with impacted staff care providers (attending physicians and nurses). In these meetings the field experiment procedures were explained and research consent packages were distributed. The training care providers (residents and fellows) were approached individually when they first started their rotation at the TRU and were similarly invited to participate in the field experiment. Remarkably, all staff and training care providers consented to the field experiment.

A technician was always present at the distant command center to assist the clinicians in using the technology involved, such as operating the camera controls and the audio communication system.

Independent variables

Distance

The independent variable of the experiment study was the distance. Two conditions were studied. In co-locational condition, the team was all co-located around the patient. In distant condition, the most senior member of the team ("attending surgeon") was asked to work with the rest of the team in the distant location (see Figure 3.5).

Experience level

During the course of the data collection, the amount of experience that each of the teams had working together grew throughout each month, as the team members worked together. At the beginning of each month, a new group of residents would arrive for training in the TRU, and would be assigned to one of the three trauma teams. Typically, they had neither experience working together as a team, nor experience working in a trauma resuscitation unit at the start of each month. By the end of each month they had been working as a "trauma team" continually for 30 days, and had gained considerable experience in both trauma medicine and in working together as a team.

Because of this contrast in experience level between the start and end of a month, the measure "experience" was selected as an independent variable with which to aggregate the data for analysis.

Injury severity score

The current study considered the variability of patient injury as a indicator for task urgency in the assessment of the effects of distance on leadership. Therefore, the Injury Severity Score (ISS) of each patient was recorded. The ISS is an anatomical scoring system that provides an overall score for patients with multiple injuries, and ranges from 0 to 75, with the mortality, morbidity, hospital stay and other measures of severity increasing linearly with an increase in ISS.

Dependent measures

The data collection procedure for each experiment case included a number of steps involving a number of measurement instruments. Because of the fast-paced and highly demanding nature of work in trauma resuscitation, it was not always possible to complete all the steps in the protocol when recording a case. However, the targeted data collection protocol involved the following measurement items and steps.

1. **Pre-admission questionnaire** [PQ(-), Appendices D-G]: a set of 4 questions regarding an individual's knowledge of and confidence about the upcoming admission.

2. **Amylase Pre** (Saliva sample): Saliva samples provided the ability to measure amylase levels, which correlate to stress levels, thus providing a measure of stress. The initial amylase level was taken before the arrival of the patient as a baseline measure.

3. **Post-Resuscitation Questionnaire** (PRQ, Appendices D-G): following the videotaping, a two-page questionnaire dealing with the team's performance during the admission was administered to the Attending, Fellow and Resident participating in the admission.

4. **Multiple Affect Adjective Check List** (MAACL, Appendix I): The MAACL provides multi-dimensional assessment of participants' emotional state, to be used to attribute a more specific cause to the stress measured by the amylase.

5. **Amylase Post** (Saliva Sample): a second saliva sample was taken immediately following the completion of the admission.

6. **Audio-video-data recordings** (Figure 3.6): the recordings of multiple camera views and screen capture from the patient monitor, which displayed vital signs of the patient.

7. **Post-Resuscitation Video Review** (PVR, Written or Audio): an assessment of performance of the team during the case was carried out by the participants, either through a written questionnaire or through audio-taped narrative commentary.

8. **Critical Procedure Analysis** (CPA, Appendix C): a structured video review to extract performance data as well as subjective ratings of tasks and performance.

Amylase

Amylase is an enzyme that hydrolyzes starch to oligosaccharides and then slowly to maltose and glucose. Salivary amylase concentrations are predictive of plasma catecholamine levels and can be used as a measure of stress (Chatterton, Vogelsong, Lu, Ellman, & Hudgens, 1996). Measurement of amylase concentration in saliva includes the observation of chemical color changes according to standard photometric procedures developed by Northwestern University (Chatterton et al., 1996). The concentration of amylase is then determined from a table of values relating time and temperature to amylase activity.

Chatterton et al. (1996) conducted an investigation to evaluate the production rates and concentrations of salivary amylase as a measure of adrenergic activity during conditions of physical and psychological stress in humans. Saliva and blood samples were simultaneously collected, and significant associations between the concentration of salivary amylase and plasma levels of catecholamines were found, suggesting that the same stimuli that increase the concentrations of plasma catecholamines may activate sympathetic input into the salivary glands.

In addition to psychological stress and physical exercise, responses to heat and cold stress conditions were also measured. The experience of heat stress resulted in increases in salivary amylase and heart rate that were expected from studies of catecholamine responses to heat. Heart rate responded more rapidly in the thermal chamber than did amylase concentrations; however, amylase remained elevated for a full 15 minutes after the subjects left the chamber. This continuing response may be similar to that observed after a critical exam and may indicate a psychological component, as reflected by the high anxiety levels reported at that time.

A clear dicotomy was demonstrated between heart rate and salivary amylase secretion during a cold stress condition and indicated a more complex response of the heart. Although cold is a potent stimulus for catecholamine secretion, the heart has compensatory mechanisms that limit the response during conditions when body temperature must be conserved. Chatterton et al. (1996) surmised that salivary amylase is a less complex and therefore a more direct measure of catecholamine levels than heart rate.

The Salivary Amylase Field Assay Kit is self-contained and is typically administered just before, during, and immediately after a stressful event or specified set of tasks. Stress levels are quantified using tabled values of time for color change and ambient temperature recording. Saliva samples for amylase assay are obtained from participants by using small, square sponges in plastic cups. The soldiers are instructed to roll the sponges in their mouths for 1 minute as they begin to complete the stress perception questionnaires. They then put the sponges in their

pre-labeled cups, cover them, and hand them to a monitor or place in a cool, insulated container. The field assay can be performed immediately, or the cups containing the samples can be left in the insulated container until the field assay procedure can be performed.

The assay procedure is performed by squeezing the cup, releasing the saliva into a vial. A portion of saliva is then combined with a pre-measured amount of diluent. The saliva-saline solution is added to a pre-measured reagent, and the time for color change is recorded.

MAACL

The Today form of the Multiple Affect Adjective Check List - Revised (MAACL-R; Zuckerman & Lubin, 1985; see Appendix I) was administered. Because of the improved discrimination validity and the control of the checking response set, the MAACL-R Today form has been found to be particularly suitable for investigations that postulate changes in specific affects in response to stressful situations. This is identical to the General form, except that subjects are instructed to answer according to how they feel "right now" or how they felt during a specified time period or event.

The Post Resuscitation Questionnaire.

The PRQ was a self-report survey that was administered immediately after patient resuscitation to the attending surgeon, surgical fellow, and surgical resident in charge of the patient (see Appendices D-G). We used the PRQ to assess participants' perceptions of team dynamics, task characteristics, leadership, and performance during the preceding admission. More specifically, the PRQ assessed several key construct areas: patient and task characteristics, leadership behavior, team processes, performance, and team history. Almost all of these constructs were assessed through multi-item scales measured with a five-point Likert response scale. Patient and task characteristics included items assessing the urgency, novelty, and uncertainty of the patient as well as the stress, time pressure, and mental effort of the task. Leadership behavior was assessed for the surgical attending, fellow, and resident in six areas: strategic direction, hands-on treatment, teaching, monitoring, praising, and remaining calm and composed. Team processes included constructs such as coordination, shared mental models, conflict, consensus, direction, learning, and teamwork. Team performance was assessed with two general items concerning the performance of the team in treating the patient. Finally, there were several items dealing with the history of the crew in terms of how much they have worked together in the last 24 hours and in their tenure in the TRU. In addition, to these self-report items, the experimental condition as well as an objective injury severity score (ISS) was also recorded.

Leadership Measures for Experimental Studies

We developed survey measures to measure the variables discussed above, including:

1. Leadership behaviors demonstrated by the attending surgeon (Monitoring others; Remaining calm and composed; Praising others; Providing strategic direction; Participating in a hands-on fashion; and Teaching). Sample items include:
    a. To what extent did the attending surgeon oversee crewmembers' treatment of the patient?
    b. To what extent did the attending surgeon remain calm throughout patient treatment?

c. To what extent did the attending surgeon give credit when crewmembers did their job well?
d. To what extent did the attending surgeon tell others what strategy to use to treat the patient?
e. To what extent did the attending surgeon provide hands-on treatment of the patient?
f. To what extent did the attending surgeon teach others how to perform a task?

2. Leadership behaviors demonstrated by the surgical fellow (Monitoring others; Remaining calm and composed; Praising others; Providing strategic direction; Participating in a hands-on fashion; and Teaching). Items are identical to the leadership items for the attending surgeon except that "attending surgeon" is replaced with "surgical fellow".

3. Leadership behaviors demonstrated by the resident in charge of the patient (Monitoring others; Remaining calm and composed; Praising others; Providing strategic direction; Participating in a hands-on fashion; and Teaching). Items are identical to the leadership items for the attending surgeon except that "attending surgeon" is replaced with "admitting resident".

4. Patient Characteristics. Sample items include:
   a. We did not have a moment to spare in treating the patient's injuries.
   b. In the TRU, we often see injuries of this sort.

5. Team Experience. Sample items include:
   a. In the past 24 hours, how many patients have you treated with the attending surgeon?
   b. In your tenure in the TRU, how many patients have you treated with the surgical fellow?

6. Team Processes (coordination, shared mental models, conflict). Sample items include:
   a. Crewmembers coordinated their tasks in a smooth and orderly fashion.
   b. Every crewmember had a shared understanding of the treatment plan.
   c. There was obvious friction between some members of the crew.

7. Treatment Episode Outcomes (learning, satisfaction, subjective rating of team performance). Sample items include:
   a. I learned new skills during this admission.
   b. I look forward to working again with the same crew.
   c. All in all, the crew performed extremely well in treating the patient's injuries.

These survey items were designed to be completed by the each team's attending surgeon, surgical fellow, and resident in charge following the completion of their treatment of a patient. Appendix I is the questionnaire used for collecting data on the leadership behaviors outlined here. (Note that the level of analysis for our study is the treatment episode – that is, the treatment of a specific patient.) Because these individuals are quite busy and because they often had to complete the same survey multiple times (regarding different teams in which they participated in

treating different patients), we anticipated that we were not able to obtain full data (three completed surveys) for all the treatment episodes.

The Critical Procedural Analysis.

The CPA was similar to the PRQ and assessed comparable constructs (see Appendix C). The CPA was a survey (rating form) completed by subject matter experts such as nurses, surgeons, and anesthesiologists who watched a videotaped admission and then rated patient characteristics, team performance, and so on. Like the PRQ, the CPA also assessed patient and task characteristics, leadership behaviors, team processes, performance, and team history. Indeed, the CPA included many of the same items as the PRQ and was also measured on a five point Likert scale. One main difference was the performance construct which was made up of eight items assessing performance indicators such as preparedness, prioritizing, correct diagnosis, and general team performance items. As with the PRQ, the condition and ISS were also recorded for each case analyzed.

Video review

Each treatment episode was videotaped. Accordingly, the videotapes were coded to obtain additional measures of the variables listed above. Subject matter experts (nurses, anesthesiologists, and surgeons) viewed the videotapes and completed a coding form that we designed to measure these variables. See Appendix H for the form used.

Experimental set up

Using the task model of initial resuscitation of trauma patient as a real-life "laboratory," we established a paradigm for studying the impact of new communication technologies on leadership and team performance. The experiment task environment was in the trauma resuscitation unit (TRU), an area where trauma patients are first brought by helicopters and ambulances into the Shock Trauma Center for trauma care. The experimental manipulation of distance was accomplished through the configuration of the study environment, which was configured both to facilitate and record advanced communications and team performance.

The task chosen for the experiment study was the initial resuscitation of trauma patients. The starting point was after the notification of a pending patient admission to the trauma center and ending point was 15 to 30 minutes after the patient was admitted. Usually by this time the patient had been evaluated and an initial diagnosis and treatment plan had been established. The data collection surrounding the admission of a patient can be conceptualized as having three phases, starting before the patient arrival, then immediately following the initial patient admission (lasting up to 30 minutes after admission), and then following the admission, within 24 hours of the completion of the initial admission (Figure 7.1, Table 7.1).

The study participants were recruited from surgical care providers (attending surgeons, surgical fellows, and surgical residents), anesthesia care providers (attending anesthesiologists, fellows, and nurse anesthetists), and trauma resuscitation unit nurses and technicians. Institutional Review Board approved the study protocol, with specific examination of the study's potential impact on standard of care, on teaching, on participants' welfare, and on the patient's privacy.

Data analysis plan

The corpus of data collected includes video footage of team behaviors, survey data from the team participants, information regarding team experience and composition, as well as objective measures such as patient characteristics, team composition, and physiological measures of stress. This body of data was a rich source of information that can be used to address a number of research questions. Because of the scope of the data and their analysis, the results are presented in the following chapters, with each chapter examining one aspect of the data analysis. The topics covered in the chapters are as follows:

- Chapter 8: Results from quantitative analysis, based on questionnaires other quantitative data. The analysis was to determine team leadership behaviors and the impact of distance.
- Chapter 9: Results from communication analysis on intra-team verbal exchanges. Chapter 11: Results from case reviews of detailed video analysis of leadership behaviors and task situations.

The field experiment was designed to be feasible in a setting with high uncertainty of the types of tasks confronting the trauma teams. Due to the constraints associated with field experimentation, we attempted to balance the gain of realism of distant leadership under stress with the loss of statistical rigor.

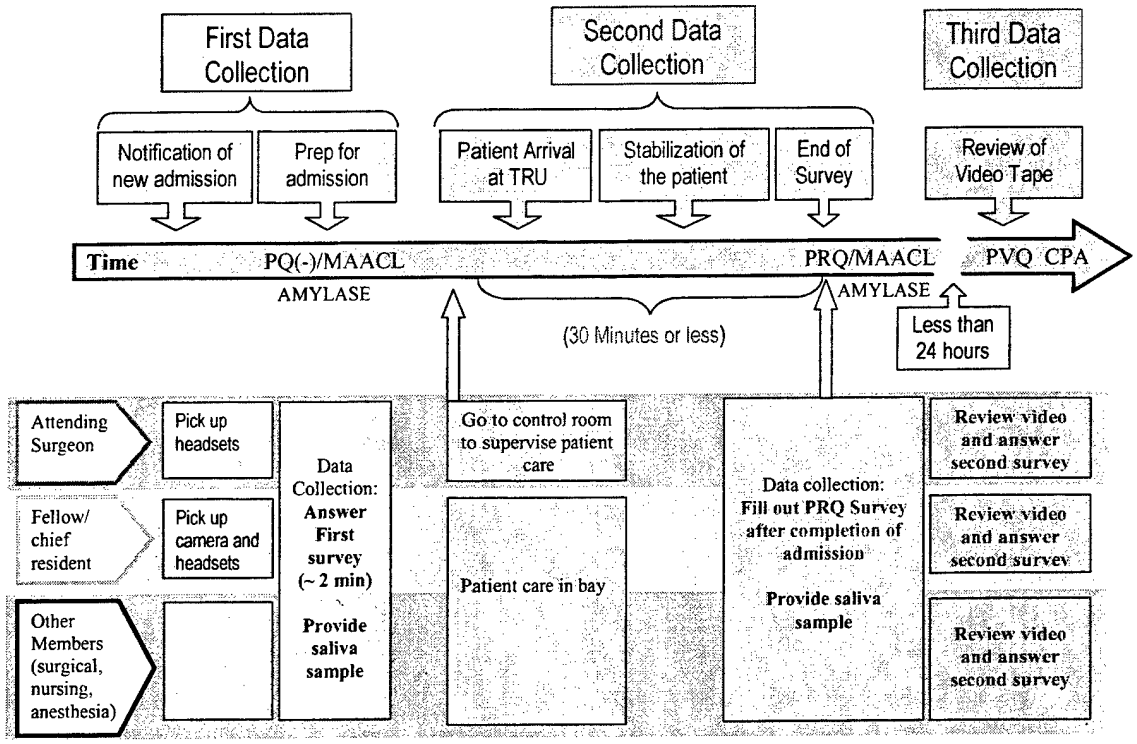


Figure 7.1: *Timeline of data collection and experimental procedures.*

Table 7.1: *Experimental procedure activities, showing the activities of the participants and experimenter during the stages of patient treatment. "Primary physician" referred to the resident assigned to a particular admission.*

Stage of Experiment	Medical Team Actors				Experimenters
	Attending	Fellow	Primary Physician	Others	Experimenter
Notification of admission					Checklist for starting the experiment: • Attending agrees and will be present • Fellow/Charge nurse informed
3 minutes before arrival	• Wear IR-audio • Go to control room to lead if in remote condition; stay near bay if in local condition • Answer PQ-	• Wear IR-audio • Answer PQ-	• Wear Head-cam • Wear IR-audio • Answer PQ-	• Participate in resuscitation	• Ask Pre-admission survey questions: • Fill in "who is who" table • Get Grease board info • Hand out headsets/ headcam • Collect saliva sample (Amylase)
Patient Arrival	• Provide saliva sample (Amylase)				• Record time that patient put on gurney
End of 2nd survey	• Provide Saliva Sample (Amylase) • Return headset				• Collect saliva sample (Amylase)
Post recording	• Answer questions (PRQ) • Answer MAACL				• Post questionnaire: Encounter survey
Optional After	• Review tape (PVR): comment on patient conditions, team activities, and attending's activities				• Collect narratives from leader and others • Collect retrospective answers to probing question (PQ) at 0 & 3 min after patient's arrival
Data organization					• Collect case information • Collect participant information

Chapter 8. Study IV (Field Experiment): Results of Quantitative Analysis

The field experiment (Study IV), as described in Chapter 7, was designed to manipulate the location of team leaders in a real environment with actual teams. A number of measures were taken, in anticipation that the measures would provided data for understanding distant leadership under stress. In this chapter, we first outline the data collected and then provide results from quantitative analysis on data collected. In Chapters 9 and 11, the results from qualitative analysis are reported.

Overview of Data Collected

Execution of experiment design

The experiment lasted for three months. All patient admissions during the hour of 11am-6pm on weekdays ("experiment days") were considered as candidate experiment sessions. The concern for the welfare of the patient and the care providers who were experiment participants was paramount in the execution of the experiment. Each candidate patient admission was assessed individually for suitability of inclusion with the care team prior to the patient's arrival based on the information the patient injury as well as current and anticipated workload of the team, especially when multiple patients were expected during a short period of time. Because of the consideration for the patients, we were aware of the potential selection bias in the experimentation.

When a case was included for the experiment (thereafter referred to as "taped"), it was assigned to either a "distant" or "local" leadership condition according to a pre-determined, random table. When a case was not included (thereafter referred to as "observed"), a set of variables about the case were collected according to a data collection sheet (see Appendix J) for the consecutive experiment days during a period of a month. Data collection on the observed cases was to assess the impact of the potential selection bias.

Study duration and case distribution

Study IV was carried out on 37 days over a period of three months. Fifty-nine cases were included in the experiment ("taped"), and 68 cases were excluded but observed ("observed"), for a total of 127 cases (Figure 8.1).

Fifty-five percent of the taped cases were assigned to local-leadership condition, and 37% in the distant-leadership condition. There was an additional 8% of cases which could not be classified as distant or local because of anomalies in the data collection process, such as the team leader in the distant condition leaving the telecontrol room (Figure 3.5) in the middle of an experiment session, or the absence of the leader for a major portion of the session.

Study participants

Consent to participate was acquired from all medical personnel asked to participate, for a total of 89 participants (Figure 8.2). Participants included faculty and staff, such as attending surgeons

(8; see Glossary for definition of terms), attending anesthesiologists (5), trauma nurses and medical technicians (13). The participants also included medical personnel in training, such as surgical fellows and chief residents (6), residents (51) and medical students (6). It is worth noting that all those who were asked to participate in the experiment provided their consent.

Eight attending surgeons participated in Study IV as team leaders. Two of the attending surgeons contributed 22% of the cases each, four contributed between 10 and 15%, and two contributed less than 10% of the cases. The distribution of cases between distant- and local conditions was generally even across attending surgeons (Figure 8.3).

Assessment of selection bias

As in any field experiments, it was important to assess potential selection biases not easily controllable or not controllable at all due to the limitation inherent in field experiments. In order to assess any potential selection bias in including and excluding candidate cases, the cases that were included in the experiment ("taped") were compared with those that were excluded in the experiment but were observed ("observed"). One potential bias examined was the time of day when a candidate patient was selected for experiment (Figure 8.4). Between 10 am and 11 am, there were a number of observed admissions, but no recorded cases. Also, between 12 and 1 pm there were more cases observed than recorded. These disparities may be attributed to the difficulty in recruiting study participants to participate in the study protocol at these hours. Aside from these two time periods, the taped cases and observed cases followed very similar distributions across time with the exception of the two notable deviations.

Another potential selection bias was due to the particular day of the experiment. Potential sources for such bias included team composition (since team composition changed from day to day). We examined the distribution of the studied cases over the course of experiment days against all candidate cases (Figure 8.5). Notice on the 21st and 34th day of the protocol, there were 12 and 8 cases observed (respectively) but no cases taped. The numbers of cases indicated a relatively high volume of incoming patients. The studied team judged on these two days that including any cases for experiment would not be feasible.

A third potential selection bias was due to the type of injuries. In other words, it was possible that the cases selected for experiment were those with different levels of injury. We compared injury severity score (ISS) for two groups of patients: those that were included in the experiment ("taped") and those were not included in the experiment but were observed ("observed"). Note that during the period of one month, all cases fall within the experiment time were either taped or observed. Fifty-five of the observed cases and 51 taped cases had records of ISS data. The mean and standard deviation of ISSs for the observed and taped groups were 8.1+/-8.1 and 8.9+/-7.4, respectively. Two-tailed t-test did not detect any significant differences. We concluded that there was no selection bias due to patient injuries.

We also evaluated the difference in staffing between the two groups of cases. In other words, were the teams for the experiment cases (i.e. taped cases) different in terms of staffing level from those not included in experiment (i.e. observed cases)? Figures 8.6 and 8.7 contrast the presence of three types of team members: the attending surgeon (the team leader and most senior member of the team), the fellow (the second most senior member), and the resident at

different points of time of a patient admission. No statistical procedures were used to assess the difference but the two figures seem to indicate differences in staffing levels. For the taped cases, the teams were more likely to be staffed with the full complement of personnel in comparison with the teams in the observed cases. Clearly there was a selection bias in that when the team members were in complete, the case was likely to be excluded from the experiment.

Lastly, we assessed the potential selection bias when a case was included in the experiment but was assigned to local or distant leadership condition in some biased manner. One potential source of such selection bias was patient injury status. When an incoming patient was expected to be more severely injured, the trauma team might be reluctant to submit the case to the distant leadership condition. To assess this type bias, we used patient injury indicator, injury severity score (ISS). ISSs from 25 cases were available for comparison between cases under local leadership condition (mean ISS=8.23+/-6.00, n=13) and cases under distant leadership condition (mean ISS=5.00+/-4.29, n=12). Although the patients in cases assigned to distant leadership condition appeared to be less severed injured, t-test results show a p-value of 0.138. Thus there may be a slight selection bias but not significantly so.

Types of data collected

As described in Chapter 7, data collection was planned for a number of variables. These data collection procedures could potentially interfere with patient care and other duties of the study participants. To ensure patient care, data were sometimes not collected. Five types of data were subject to such potential interferences: pre-admission questionnaire (PQ-), post-trauma questionnaires (PRQ), multiple affect adjective check list (MAACL), post video review (PVR), and amylase. Table below lists the number of cases in which surveys (PQ-, MAACL, PRQ), amylase samples, or reviews (PVR) were collected from *at least one* study participant.

Data collected from cases in local, distant and other conditions. The number in each cell represents the number of cases with at least one data point in that given category of measurement.

Condition	PQ(-)	MAACL	Amylase	PRQ	PVR (Written & Audio)
Local	9	8	4	17	1 & 5
Distant	16	18	4	19	9 & 11
Other	2	0	4	0	0

The table below breaks down the distribution of three surveys (PQ-, PRQ and MAACL) by the type of participant—attending, fellow, or resident. Residents provided the most data points than attending surgeons and fellows. In reference to Figure 8.1, one may notice that only eight attending surgeons and six fellows/chief residents participated in the experiment, whereas there were 51 residents in the experiment. So most attending surgeons and fellows/chief residents filled out questionnaires more than once, while many residents did not fill out once.

Data collected from three groups of participants. The number in each cell represents the number of cases with at least one data point in that given category of measurement.

Role	PQ(-)	MAACL	PRQ
Attending	16	16	24
Fellow	13	15	23
Resident	27	28	34

Out of the 59 taped cases (i.e. cases included in the experimentation), 29 had PRQ data from multiple team members, for a total of 70 filled PRQ forms. The reason for missing PRQ forms was that during the experiment, it was sometimes difficult for participants to complete the PRQ due to time constraints immediately after the experiment sessions. For example, in some cases the participants needed to take the patient immediately into the operating room or another patient would arrive which required immediate attention. As a result, the participants in these cases would have little time to complete the PRQ.

Critical procedure analysis (CPA) was carried out on 18 of the 59 taped cases. Recall that CPA was conducted with neutral (i.e. non-participant) subject matter experts while they were reviewing videotaped cases, with the assistance of an analysis tool (CPA form; Appendix C). The rest 41 cases were not used in CPA due to defects in videotaping. The defects were due to either procedural (e.g. taping started too late) or audiovisual (e.g. poor sound quality) abnormalities. Each of the 18 cases was reviewed by two surgical SMEs, one anesthesia SME, and two nursing SME. A total of 80 filled CPA forms were collected.

In addition, 45 saliva samples were taken from the participants for determining amylase levels.

Assessment of data quality

The unit of analysis for all statistical procedures was experiment session or case: the data collected from the trauma team and reviewers for a particular patient admission. Therefore, it is necessary to group or aggregate individual participants' responses regarding the same admission and similarly to group or aggregate subject matter experts' reviews during critical procedure analysis (CPA; Appendix C) regarding a given admission.

Before aggregation of the data to the case level, it is necessary to justify this aggregation and illustrate group level properties. In particular, justification for aggregation can be assessed with the ICC(1), ICC(2), and $r_{wg(j)}$ statistics. The ICC(1) tests how much of the variability in individual responses can be predicted by the case to which the data is being aggregated. The ICC(2) tests the reliability of the grouping variable means. The $r_{wg(j)}$ assesses the agreement or degree to which raters provide essentially the same rating in order to determine if individual ratings are interchangeable. Thus, the ICC(1) and ICC(2) can be thought of as reliability based approaches while the $r_{wg(j)}$ can be thought of as an agreement approach.

In general, there is modest support for aggregation of data from the PRQ. Specifically, the average ICC(1) of the PRQ scales is .041 and the average $r_{wg(j)}$ is .671. Further, the ICC(2) values tended to be rather low; however, these low values are to be expected as ICC(2) values are a function of sample size and one would predict that they would be very low with only two or three respondents per case. The average ICC(1) value of .041 indicates that on average, a 4.1% of an individual's response can be attributed to the case they were rating. While this ICC(1) value is rather low based on conventional standards, we felt it was indicative of acceptable agreement in the current environment as much of the PRQ relied on ratings of high velocity and dynamic events. In addition, while the average $r_{wg(j)}$ was somewhat lower than the recommended level of .70, we felt this value provided justification for aggregation as it indicated an acceptable

level of agreement given the nature of the environment. Further, only case-level analyses made conceptual sense as Study IV did not assess individual-level dynamics and effects.

The aggregation statistics for the CPA tended to be more encouraging than the PRQ as more individuals tended to complete the CPA and ratings were based on videotape analysis in which one could review the tape multiple times. Thus, the average ICC(1) for the CPA scales is .167 and the average $r_{wg(j)}$ statistic for the scales is .627. Again, based on the current characteristics of the study, we interpreted these values as providing acceptable evidence for aggregation. Thus, all analyses were conducted at the group level.

Performance and Leadership Behaviors

As described in Chapter 7, the two instruments developed for Study IV, post-resuscitation questionnaires (PRQ) and critical procedural analysis (CPA) trauma, provided much of the data needed to address essential questions on team leadership, team performance, stress, and the potential impact of distance leadership. We structured data analysis on the questionnaire data to answer following questions.

(1) Whether the distant or local condition had an impact on the processes or outcomes in treating a patient.
(2) Was team performance related to the six leadership behaviors exhibited by the attending surgeon (the team leader), the fellow, and residents in a trauma team.
(3) Was task characteristics and team processes related to team performance.
(4) What was the relationship of leadership behaviors among the three main individuals: the attending surgeon, surgical fellow, and surgical resident in charge of the patient. In particular, we explored the relationship among attending and fellow leader behaviors, attending and resident leader behaviors, and fellow and resident leader behaviors.

In summary, these questions explored the impact of condition, the impact of leadership on performance, the relationship of other factors and performance, and the relationship among different leader behaviors.

Subjective performance measures

Team performance was measured in both PRQ by participants and CPA by SME neutral reviewers. Ratings of overall team performance in CPA by SME surgeons, anesthetists and nurses showed that there was little agreement between experts regarding team performance (ICC = .11). Breaking the ICC down to the component pairs we found that surgeons and nurses had a reasonable degree of agreement on this item (ICC=.51), whereas no significant agreement was present between anesthesiologist-surgeon pair (ICC=.-.02) or the anesthesiologist-nurse pair (ICC=.05).

In the self-rated performance questions in PRQ, participants rather than experts answered questions regarding performance. The PRQ contained two questions regarding absolute and relative performance. Responses to these questions were closely related (a=.79). Here, too, however, there was little agreement between attending surgeon, fellow and resident on these ratings (ICC=.09).

Speed and Accuracy Measures of Performance

Team performance was assessed through subjective measures contained in PRQ and CPA. Event timings during trauma patient resuscitation can potentially provide measures of team performance in terms of speed of achieving certain task landmarks and accuracy in following established task sequences. The so-called Advanced Trauma Life Support (ATLS) protocol, established by American College of Surgeons, is widely accepted as standard of care in trauma. The protocol contains a list of steps in carrying out the treatment of a trauma patient.

Based on the ATLS protocol, a task list of 28 steps was developed for performance measurement (Table 8.1). The task list was used to measure accuracy through checking for omissions of steps and to measure speed through completion of key landmarks as indicated by the task list. While filling CPA forms, SMEs reviewed recorded video and indicated (i.e. marked) the timing of completion of the steps in the task list. If steps on the list were not observed, they were marked as "omitted," and no time was recorded. SMES were also asked to judge whether particular steps were applicable or not to the current patient. For example, some patients were transported to the trauma center with the neck immobilized and oxygen applied by the field care providers. The absence of these two steps in the task list was not counted as omission but as not applicable. The omission was measured by number of steps omitted among the number of total applicable steps.

The time from the patient arrival to completion of the last step recorded of the task list by the team was used for speed measure. For example, the very last step of the task list is "Overall plan announced to all". Usually finishing that step would constitute the task completion time. However, when that step was omitted, or one of the other steps was finished afterwards, whatever was finished last would be the last step recorded.

A total of 25 cases were available for extraction of speed and accuracy measures. The defects in audio-video recordings of the remaining cases prevented the data extraction. Among the 25 cases, 13 were under local leadership condition, and 12 distant leadership condition.

Stress measures

One important variable measured in different ways in Study IV was stress. In survey questionnaires (PRQ and CPA) summary items regarding stress were asked. MAACL was used to assess more comprehensively various aspects of stress. Saliva samples were taken to measure physiological response to stress (amylase levels).

The stress measurement in PRQ was designed to measure three components or stressors: mental effort, psychological stress and time pressure. These three components were found to be internally consistent (Kronbach alpha = .89). However, perception of the stress of a given admission was not shared among different participants in the resuscitation. There was no agreement between attending surgeons, fellows and residents (ICC = -.02, $p<.5$).

In CPA, SMEs were also asked to assess how stressful a case was to them as neutral observer. Specifically, CPA asked their agreement with the statement, "this admission was very stressful to the care providers". Nurses, surgeons, anesthesiologists rated each admission on a scale of 1-5. Taken as a group, the agreement between these SMEs was reasonable (ICC= .46,

p<.001). While generally, an alpha rating of .8 is often considered a standard cutoff, the current alpha level, while not ideal, shows a reasonable level of consistency and common variance. Further analysis into assessment of stress showed that the anesthesiologist SMEs agreed with the nurse SMEs (ICC= .44) and with the surgeon SMEs (ICC = .59), but there was little agreement between the nurse SMEs and the surgeon SMEs (ICC = .29).

In addition, physiological measures of stress were taken as the amylase derived from the saliva samples of participants. These samples were difficult to acquire due to the logistics of interrupting a trauma admission to attain saliva samples from the participants during patient admissions. Samples that were collected were processed but were inadequate for cross comparison with other measures of stress. Similar limitations existed for MAACL measures of stress. These two types of measures were used in correlational analysis later.

Relationship among stress measures

One could assert that the sicker the patient, the more stress and workload that patient's admission would induce. By this logic, a valid and reliable measure of patient injury would be a good proxy for predicting stress level. Therefore, the Injury Severity Score (ISS) was used as an objective measure to indicate the nature of each admission in terms of stress and urgency required for provision of patient care. The ISS is an anatomical scoring system that provides an overall score for patients with multiple injuries, and ranges from 0 to 75, with the mortality, morbidity, hospital stay and other measures of severity increasing linearly with an increase in ISS. This measure is calculated through a standardized methodology as a part of the hospital-generated patient data, and has been validated as an objective measure (Baker, 1974).

To triangulate the stress measures deployed, we compared the measures stress with ISS and found ISS was closely related to stress measures. The Pearson correlations between stress measures in PRQ and ISS were significant: $r(19) = .522$ ($p < .022$) for stress, $r(19) = .632$ ($p < .004$) for time pressure, and $r(19) = .568$ ($p < .011$) for mental effort. Similarly, the stress measure in CPA was also closely related to ISS (Pearson $r(23) = .428$, $P < .041$).

There was difference in stress measures between study participants (who filled questionnaires about the case they participated) and neutral SME reviewers (who viewed videotaped patient admissions in which they did not participate). Agreement between the non-participating experts and the participating care givers was low. This may reflect how participants view stress differently than those, even intimately familiar with the domain and exact settings (all SMEs had extensive experiences working in the studies trauma center), who were neutral observers.

Effects of the distance manipulation

The PRQ data (provided by study participants) indicated no impact of distance manipulation on interested dependent variables. A potential selection bias was detected: teams in the distant condition had a significantly longer shared history than teams in the local condition ($r = .52$). The CPA data indicated several impact of distance on leadership behavior: attending hands-on leadership behavior, attending praising leadership behavior, fellow hands-on leadership behavior, and fellow monitoring-leadership behavior. In particular, the attending was less hands-on in the

distant condition (r = -.612) and praised more in the distant condition (r = .536). Further, the fellow was both more hands-on (r =.456) and monitored (r = .521) more in the distant condition.

When omission was used as an accuracy measure, there were significantly (p=.017) fewer omissions in distant leadership condition (8.2+/-2.2) than there were in local leadership condition (11.5+/-3.9). Note the numbers were for the steps omitted. However, when time to task finish was used as a speed measure, it took significantly (p=.045) longer to finish the task list in distant leadership condition (883.8+/-422.2 sec) than there were in local leadership condition (609.7+/-192.8 sec).

Stress measures collected have provided indication of impact of distance manipulation. When comparing the two experiment conditions, the team leaders (attending surgeons) reported (in PRQ) higher stress in all three components (stress, time pressure, and mental efforts) in the distant leadership condition (Figure 8.8). Note that in distant leadership condition, it was the attending surgeon of the team who was distant to the rest of the team. When the stress ratings from other team members (fellows: Figure 8.9; residents: Figure 8.10) were compared, there was no significant difference between the distant and local leadership conditions.

One of the measures assessed by MAACL was anxiety. When the anxiety scores were compared across the two experiment conditions (Figure 8.11), both residents and attending surgeons, but not the fellows, indicated elevated anxiety in distant leadership condition.

The difficulties in consistently collect salivary samples for amylase measurements were more than anticipated. Only a small subset of the study participants were able or willing to provide saliva samples (Figure 8.12). No conclusion was made for amylase data.

Leadership Behaviors

Would leadership behaviors lead to improved team performance? Results of the PRQ indicate that there were no significant relationships between the six leadership behaviors and team performance for either the attending surgeon (the team leader) or the fellow (the second most senior member of a trauma team). However, results indicated three significant relationships for the leadership behaviors from the resident: strategic direction (r = .42), teaching (r = .41), and praising (r = .37). These three leadership behaviors had a positive relationship with team performance such that more strategy, teaching, and praising leadership behaviors exhibited by the resident was related to higher team performance. Analysis of the CPA data indicated that two attending surgeon leadership behaviors and four resident leadership behaviors were related to team performance. Specifically, greater attending surgeon monitoring (r = .441) and remaining calm and composed (r = .586) was related to higher team performance. Further, the resident leadership behaviors of strategic direction (r = .633), hands-on (r = .616), teaching (r = .424) and remaining calm and composed (r=.604) were all also positively related to team performance.

Other Predictors of Team Performance

The task characteristics for trauma teams measured by PRQ included novelty of and uncertainty about patient injuries. Both of these two variables correlated with team performance positively and significantly (r=.37). This result suggested that the greater novelty and uncertainty, the better

the team performance. Team process variables measured in PRQ were also related to team performance: coordination (r = .44), shared mental models (r = .59), learning (r = -.32), satisfaction (r = .48), and teamwork (r = .74). Thus, one can see that these process variables were all positively related to team performance except for team learning which was negative. The CPA data also indicated that several factors were related to team performance. The task characteristics measured in CPA were all negatively related to team performance: urgency (r = -.436), instability (r = -.610), riskiness (r = -.721), and stress (r = -.683). Further, the team process variables of coordination (r = .751), shared mental models (r = .857), and timely treatment (r = .803) were positively related to team performance such that greater levels of these process variables was related to higher team performance.

When the task urgency was measured by the extent of patient injury or ISS, no significant differences were detected in terms of speed and accuracy measures. We compared those cases with ISS score of 5 or higher ("ISS high") with those with ISS score less than 5 ("ISS low"). The means and standard deviations for ISS high and ISS low groups were 769.5+/-346.2 and 710.8+/-358.8, respectively. There was no difference (t(23)=.77, p=.68). The task omissions for the two groups were 10.5+/-3.3 and 9.2+/-3.8. Again there was no difference (t(23)=.96, p=.35).

Interpretation and Discussion

The above results suggest several implications for distant leadership research. In particular, for highly specialized and trained teams, distance did not appear to impact on team performance. This lack of an effect for the distance seems to suggest that similar outcomes occur even if the team leader (the most senior member of the team, the attending surgeon) is not physically present with the team. Distance did impact on several leadership behaviors, some of which were expected, such as less hands-on behavior when distant. It was interesting to note that when the leader was distant, the second most senior member of the team were observed to provide more leadership behaviors.

Data analysis on PRQ and CPA data suggested that the leadership of the resident (a junior member of the trauma team) may have the largest relationship with team performance. In particular, the data from both PRQ and CPA indicated several resident leadership behaviors that were positively correlated with team performance. This finding is interesting as it suggests that team performance may ultimately rest in the leadership behaviors of junior members. In particular, this finding may indicate that team performance is higher when junior members display more leadership, and that if junior members are as competent as senior members then the team will perform well regardless of the leadership displayed by more senior members.

It is interesting to note the differences between the results from PRQ and from CPA in terms of relationships between performance and task characteristics. Based on PRQ data, the team performance, as self-judged by the study participants, was positively related to novelty and uncertainty. Perhaps when a case was more challenging, the team members felt they performed better. The CPA data from neutral reviewers, on the other hand, suggested a negative correlation between team performance and task characteristics in terms of urgency, instability, and riskiness. Perhaps a neutral reviewer would like to see better team performance under challenging situations.

The differences between the results from PRQ and CPA may be attributed to several sources. The PRQ data were obtained from individuals immediately after they participated in patient treatment while the CPA data were collected from non-participants who reviewed video recordings of treatment.

There are several potential reasons for the lack of a greater number of significant relationships among the variables. First, one limitation was the sample size of the experiment. The analysis of PRQ data were based only on 29 of the 59 taped cases; the CPA was performed on 18 taped cases. Although these numbers appear to be small, it is important to note that the experiment was carried out in real life environment with high-stake tasks and highly skilled, real teams. The limitation in sample size made it difficult to detect effects. Another potential reason was the nature of the task. In particular, treating trauma patients is very fluid, dynamic and varied. Based on this rapid environment, it may be difficult to accurately rate the variables of interest.

The differences in task completion time (speed) and omissions (accuracy) between the two conditions of the experiment (local and distant) could be a speed-accuracy trade-off in response to the location of the leader. When the leader was distant, the team may proceed more deliberately, and the leader may supervise better.

A prominent impact of distant leadership was the stress felt by team members. The data suggest that the team leader was most sensitive to distance manipulation, as reflected by subjective stress measures and by the anxiety scores of MAACL. In trauma teams in the studied trauma center, the team leader (the attending surgeon) bears the ultimate responsibility for the well-being of the patient. When distant to the rest of the team, the leader might felt stressful and anxious while the rest of the team were treating trauma patients.

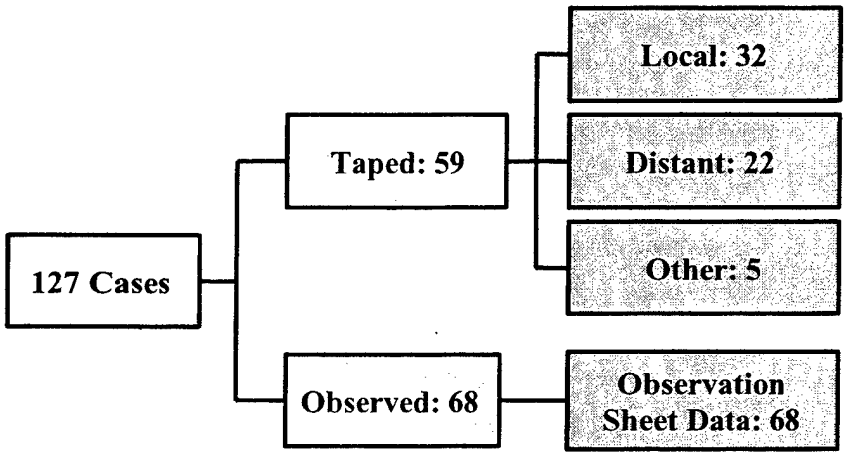


Figure 8.1: *The breakdown of cases into taped cases (included in the experiment study) and untaped cases (observed to collect data on patient injury status and care provider statistics). Taped cases involved experimental manipulations of leadership into local leadership conditions, in which the attending surgeon (team leader) was located with the rest of the admitting team, and distant conditions, in which the attending surgeon (team leader) led the rest of the team remotely from the video-control center. There were also "other" cases taped in which the leadership condition was neither due to anomalies in the experimental procedures.*

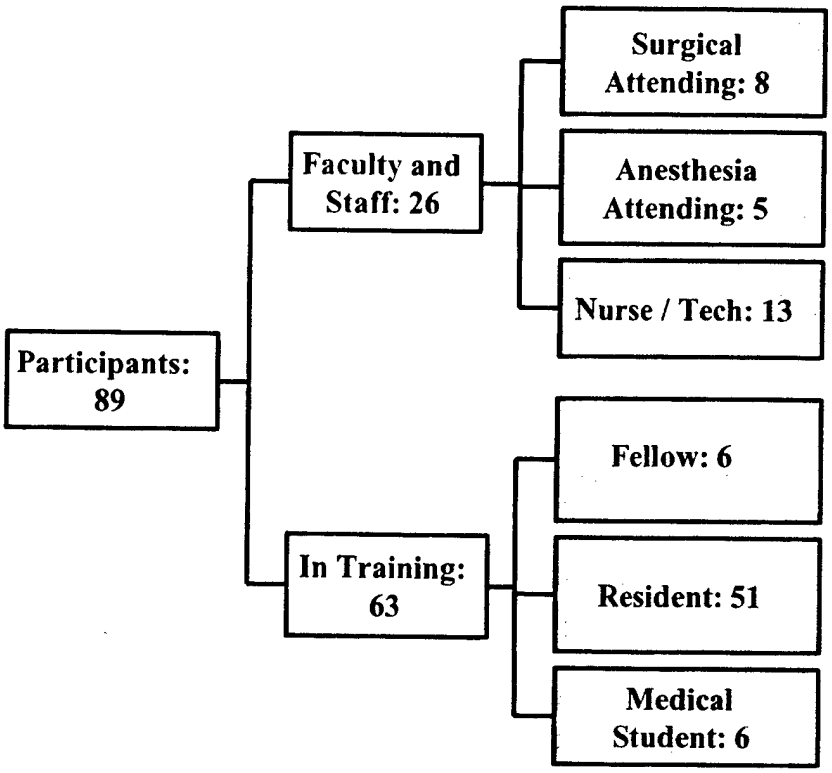


Figure 8.2: *Demographics of active participants in Study IV included faculty and staff, and medical personnel in training. Surgical attending physicians supervised the care from either distant or local locations. Anesthesia attending physicians, as well as the nursing and technical staff did not directly participate in the distance manipulations, although they did participate in the patient care. Fellows, chief residents, residents and medical students were involved in direct patient care in the admitting area, and were directly supervised by the surgical attending physician.*

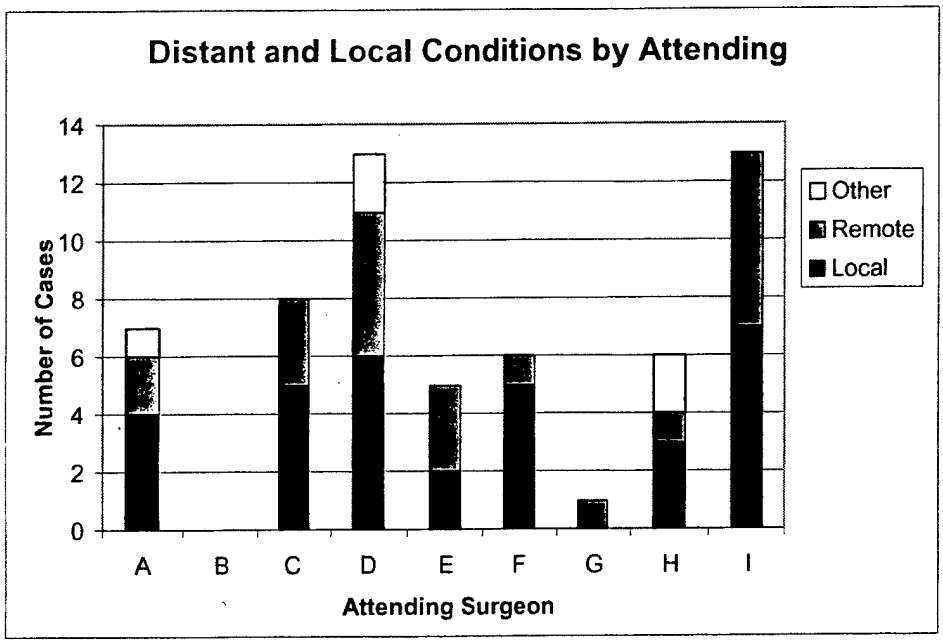


Figure 8.3: *Distribution of cases across attending surgeons (team leaders) in the different leadership conditions. Most attending surgeons participated in both remote and local leadership condition in about the same proportion. In local conditions, the attending surgeon was located with the patient and team, while in the distant leadership condition, the attending surgeon (team leader) was located in the telecontrol center. "Other" cases reflected cases in which anomalies occurred, such as when the attending surgeon began a distance leadership session and left the telecontrol center before the end of the session.*

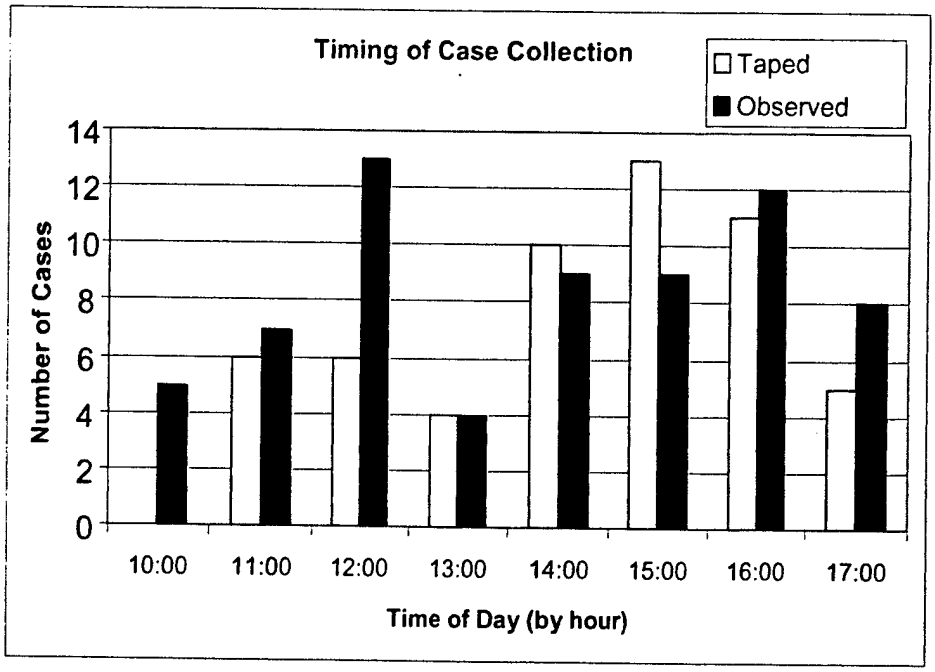


Figure 8.4: *The distribution of cases over the time of day. Cases were observed or taped between 10 AM and 6 PM, Monday through Friday. When cases could not be taped, they were "observed." Taped and Observed cases followed a very similar distribution over the course of the day, suggesting that the sampling of taped cases was a representative sample of all cases during the time when the experimental procedures took place.*

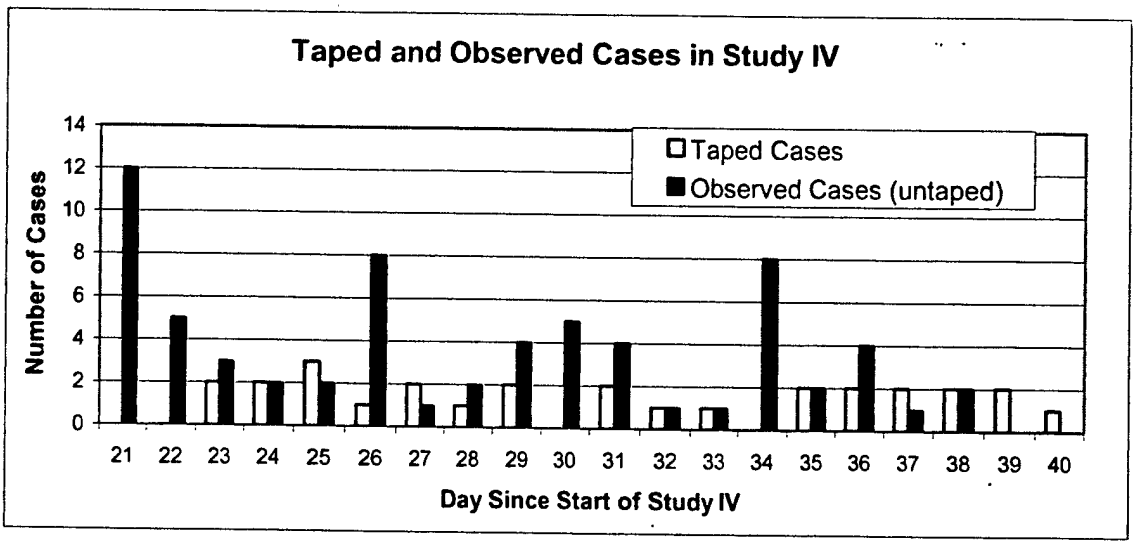


Figure 8.5: *Distribution of taped and observed (untaped) cases. Patient injury status and care providers present during resuscitation from all candidate cases were captured either through taping or though observation.*

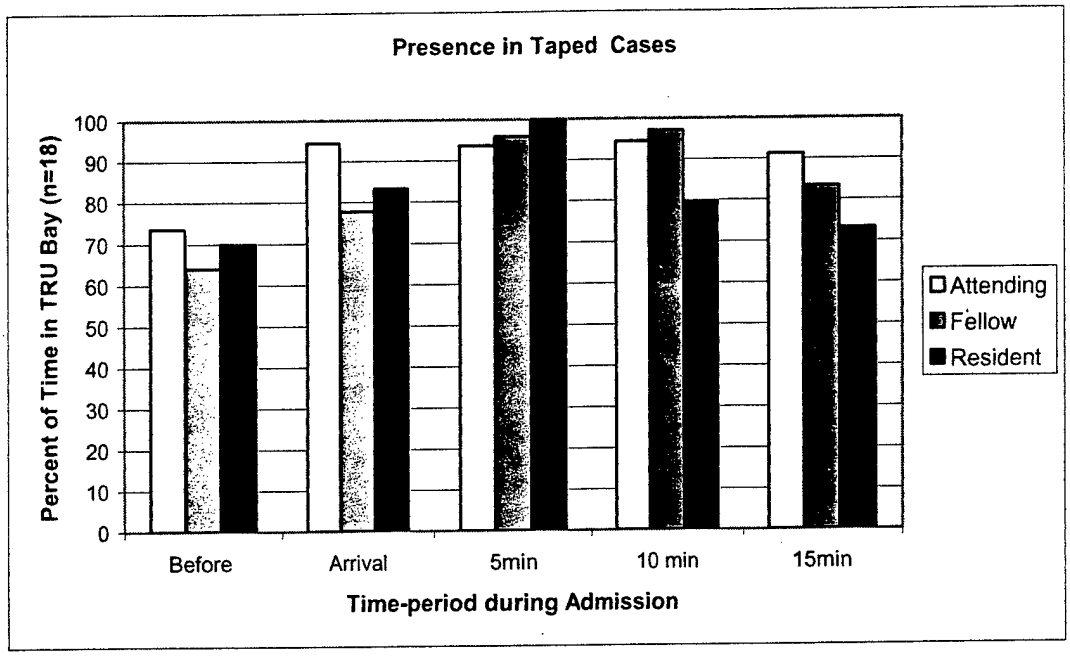


Figure 8.6: *Proportion of time (%) present during the study period in trauma cases in taped cases for attending (team leader), fellow, and resident surgeons.*

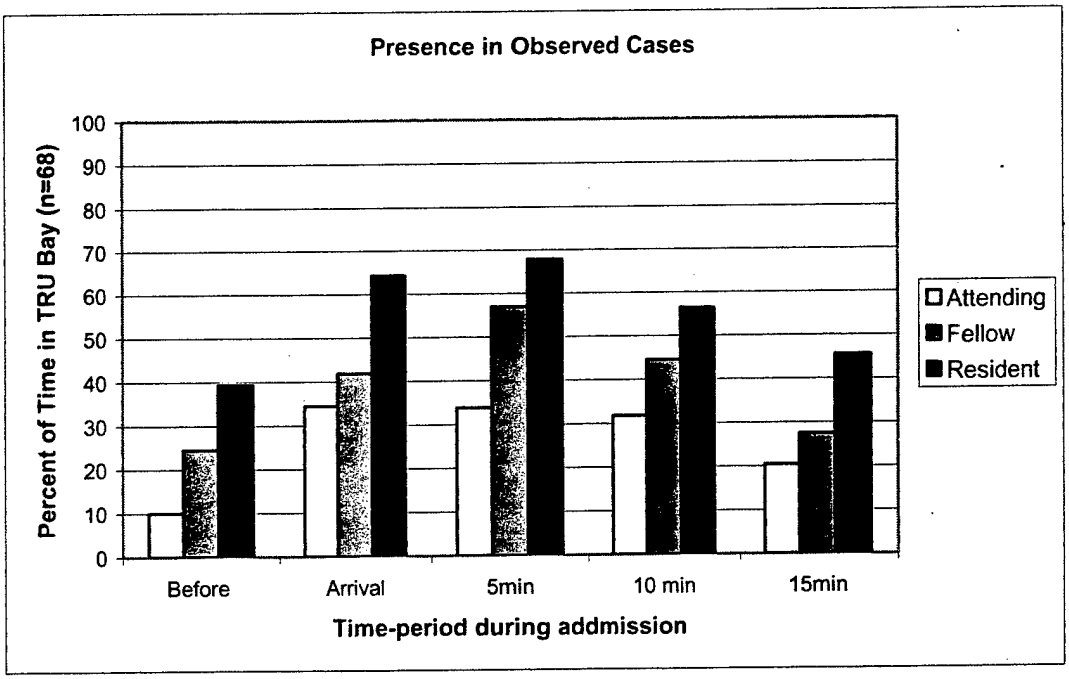


Figure 8.7: *Proportion of time (%) present during the study period in trauma cases in observed (untaped) cases for attending (team leader), fellow, and resident surgeons.*

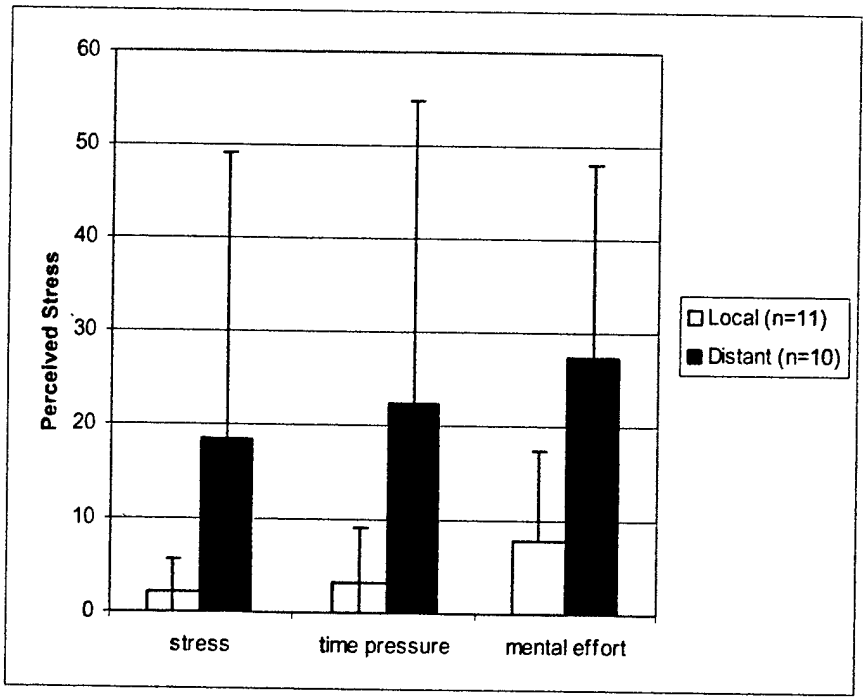


Figure 8.8: *Attending surgeon (team leader) self-reported perceived stresses in distant and local leadership conditions, on an analog scale of 100 points (higher was more stressful). Error bars show the standard deviations.*

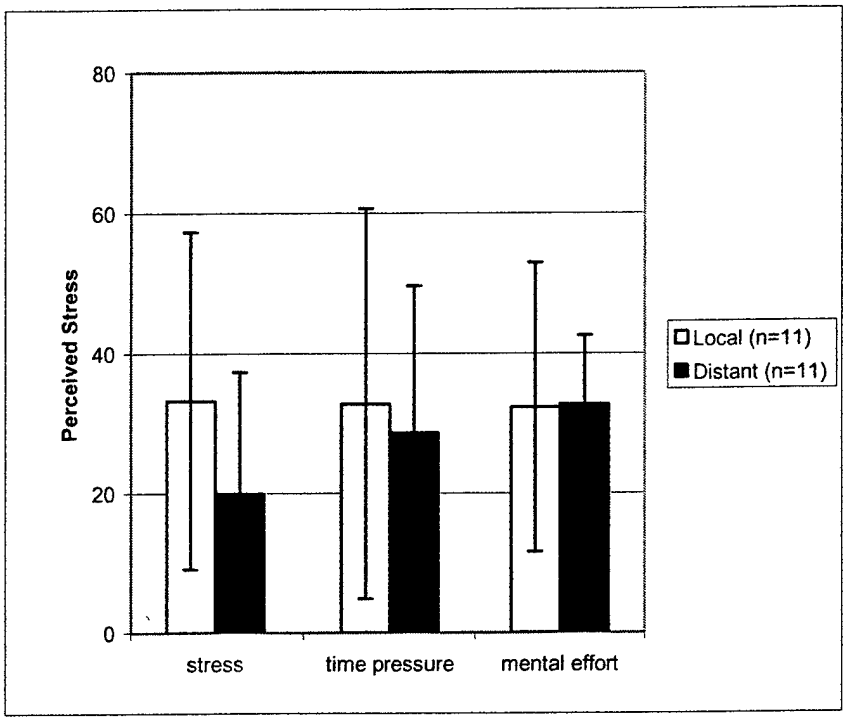


Figure 8.9: *Fellows' (senior team members') self-reported perceived stress in distant and local leadership conditions, on an analog scale of 100 points (higher was more stressful). In distant leadership conditions, the team leader (attending surgeon) was at a distant location, and communicated to the team by telecommunication link. Error bars show the standard deviations.*

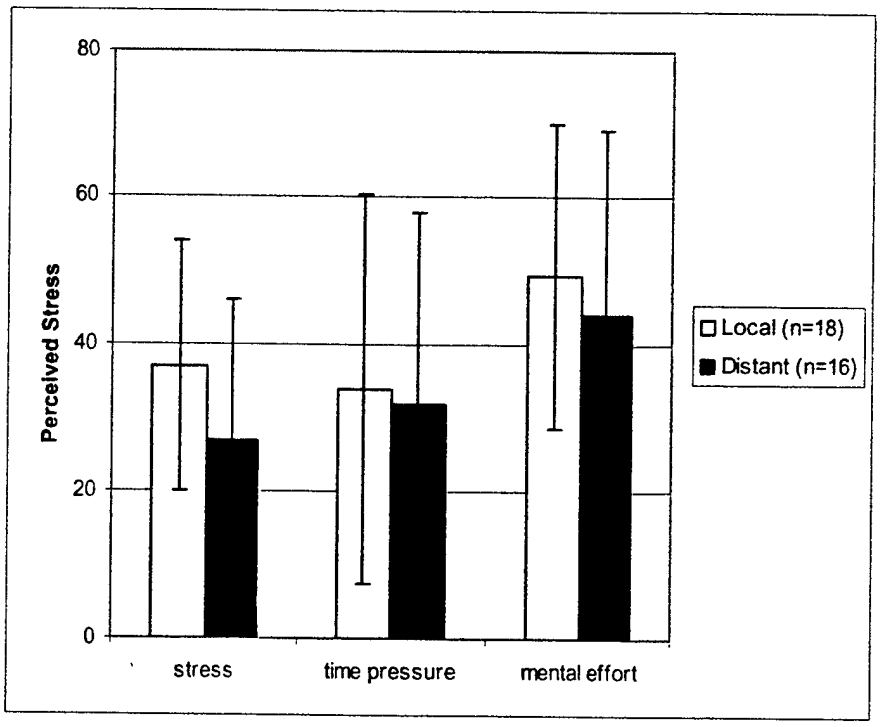


Figure 8.10: *Residents' (junior members') self-reported perceived stress in distant and local leadership conditions, on an analog scale of 100 points (higher was more stressful). Junior members were at the patient site in both local and distant leadership conditions. Error bars show the standard deviations.*

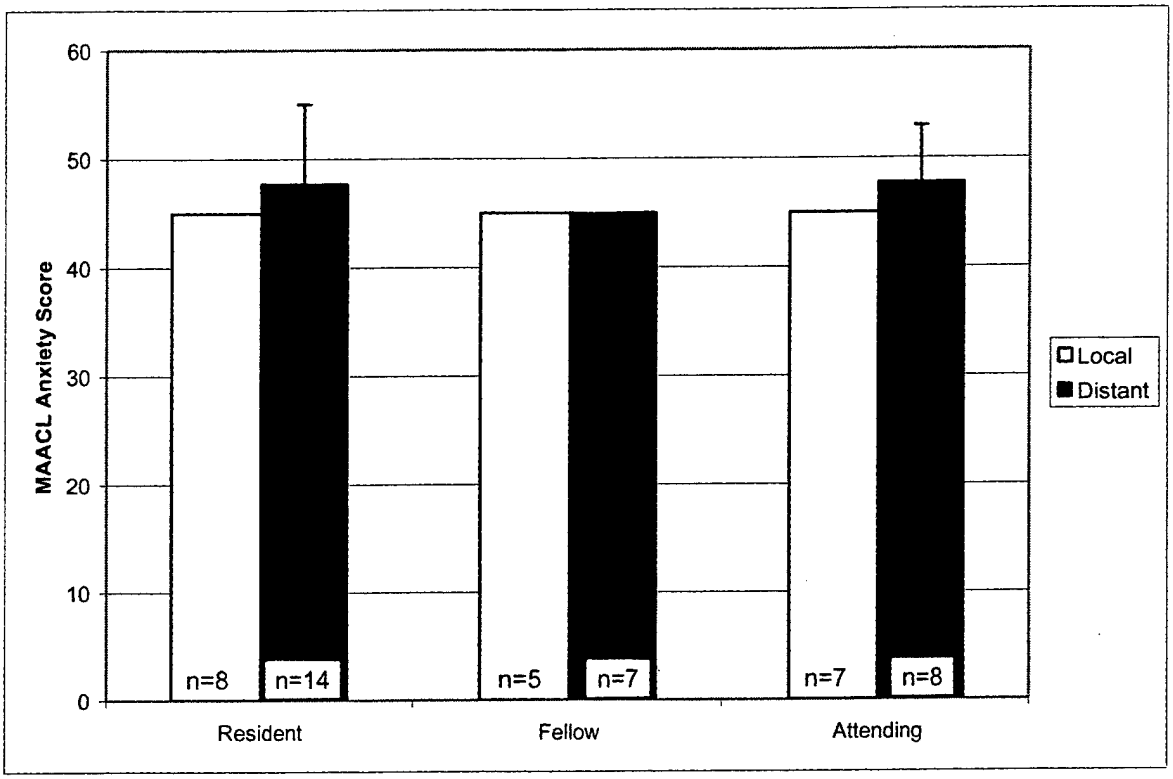


Figure 8.11: *MAACL Anxiety-scale scores for residents (junior members), fellows (senior members), and attending surgeons (team leaders) in distant and local leadership conditions. Error bars show the standard deviations; standard deviations are zero when not visible.*

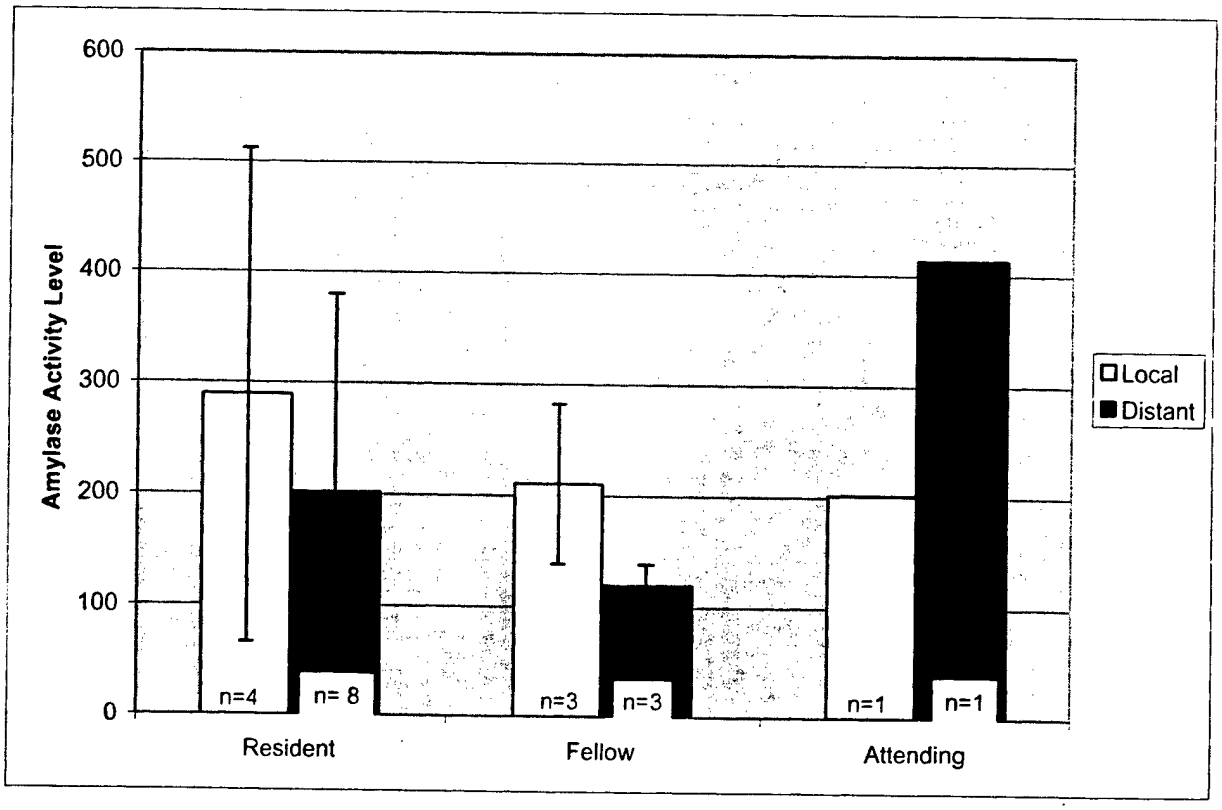


Figure 8.12: *Amylase activity level for attending surgeons (team leaders), fellows (senior members), and residents (junior members) prior to the start of a session (i.e. before the arrival of the patient). Error bars show the standard deviations; standard deviations are zero when not visible.*

Table 8.1 *Steps included in the task list based on ATLS Protocol*

Step #	ATLS Step Name
1	Airway Immobilize neck
2	Apply oxygen
3	Check mouth/oropharynx
4	Maintain airway (Guedel, etc.)
5	Breathing Inspect chest
6	Palpate chest
7	Auscultate chest
8	Circulation, Expose entire patient
9	Blood pressure
10	Check manually if abnormal
11	Pulse oximetry
12	IVs placed w/ appropriate size & # of lines
13	IV fluids ordered
14	Secondary survey (start) Head
15	Ears
16	Eyes
17	Face
18	Chest
19	Abdomen
20	Extremities
21	Log-roll
22	Inspection and palpation spine (during log roll)
23	Assess Rectal bleeding (during log roll)
24	Check bloods sent
25	Ultrasound exam (FAST)
26	Chest X-ray
27	Direction to radiographer
28	Overall plan announced to all

Chapter 9. Adaptation of team structure: Communication analysis

In this chapter, we propose an approach to the study of distant leadership under stress through analysis of communication by distributed teams. The approach was used in two types of data analysis of a field experiment study on distant leadership under stress in a real-life setting. The first was on the debriefing interviews (post video review or PVR) after each session of the field experiment (conducted in Study IV and reported in Chapter 8) to understand themes related to team structures. The second was on the verbal communications among trauma team members during the field experiment. A set of archetypes of team structure was developed based on interviews with members of trauma patient resuscitation teams. A set of hypotheses is then proposed to illustrate the adaptation of team structure due to the impact of location of the team leader, task urgency, and team experience. Then the chapter reports the results of an exploratory analysis on verbal communications during the field experiment. Implications for team leadership research in general and for distant leadership research in particular are discussed in light of the results from the field experiment.

Analysis 1: Archetypes of team structure, leadership and intra-team communication

Method

Within a short time (mostly within hours but occasionally within a week) after the end of each field experiment session, debriefing interviews with the participants were carried out while reviewing the videotaped case just finished (PVR). The participants were asked to answer three broad questions while reviewing videotaped performance: what was the patient doing, what was the participant doing, and what was the team doing. The debriefing interviews were audio-taped and transcribed. The content of the transcripts was analyzed for themes about team structures. A total of 33 debriefing interviews with attending surgeons, fellows, residents and nurses after 19 trauma cases were conducted and transcribed. Three themes on team structures were identified.

Themes

Maintaining a hierarchical team structure

The team leader, the attending surgeon, could choose to exert direct influence on anyone in a team. In the cases recorded in our study, however, the leaders communicated infrequently with the rest of the team. It appears that the leaders controlled carefully with whom they talked and who could hear what was said. Five segments from the review commentaries bore this theme out:

> *"I think Attendings have a tendency to talk to the Fellow first. For the most part, they may take us aside." (A fellow)*

Here, the fellow, as the second most experienced member in the team, was under training to be a full-fledged attending physician, expressed his observation that the team leader tended to limit his or her contact with the rest of the team to the fellow. Similar observations were confirmed by an attending physician:

> *"[E]verything I say I say to [the fellow] and then [the fellow] tells it to the junior residents because he's supposed to be running the resuscitation with them" (Attending)*

The team leader clearly wanted to maintain a hierarchy, so that the fellow was given the maximum opportunity to learn and lead.

"I want the fellow tell the medical students what to do." (Attending)

The team leader here clearly preferred a hierarchy in communication. Similarly, fellows as the second most senior member in a team learn to work like the team leader:

"I try to let [residents] make as many decisions as possible, at least come up with a plan. And if I disapprove, or disagree, we go from there." (Fellow)

Instead of dictating what the rest of the team should do, this fellow expressed that he preferred a supervisory role.

Adaptation of team structure due to perceived task urgency and criticality

Although a hierarchical structure appeared to be the preferred way for the studied teams to work, the teams were seen to adapt their structures to the needs of tasks. We observed that the more senior members of a team were involved more when the patient was severely injured. One team leader reflected on a case just reviewed:

"After [the patient] arrived, we realized he was talking, felt his pulses; realized he was not as ill as he sounded on transfer. So it switched from being a chief-and-attending resuscitation back to being a senior ER resident just running their plan past me." (Attending)

In this segment, "chief" was the second most senior member (much like the fellows discussed above); "senior ER resident" was a third year emergency medicine resident and was the third most senior member of the team. The two most senior members of the team had planned to be directly involved due to the anticipated seriousness of the patient's injury. The team adapted its structure to allow more training opportunity for the residents. Another team leader echoed the similar need to adapt the team structure:

"Usually what I would do is I allow the fellow to tell me what they want to do. That way it becomes more of a teaching situation. So that if I disagree with it I can say 'well I disagree because A B C or D' so I always let the fellow give me his plan first unless the patient is so unstable then I just say 'hey we're going to do this, this and this.' And that's just the way it is." (Attending)

Thus it was apparent that one purpose of the monitoring behavior by the team members was to determine the proper team structure. The team leader, as the most senior member of the team, expressed how she would decide to be more or less involved in activities. When situation is not urgent, the team leader will likely be in monitoring mode:

"I think, on this case it was a question of just overseeing and making sure that all of the appropriate decisions were made, the proper exam was performed." (Attending)

"I usually let the admitting resident decide who he wants to do what. If I don't approve then I will speak up. If the patient is very sick then usually myself or the senior resident becomes more involved than the junior residents are less involved" (Fellow)

Archetypes of team structures

After reviewing the transcripts, the variations of team structures can be captured in four archetypes (Figure 9.1). We will use a five-member team for illustration: leader, senior members, two junior members, and a collaborator. The collaborator is actually one or more people who are

not in the hierarchy of experience and may be from different disciplines than the other four members.

Formal team structures. In this type of team structures, the authority and experience hierarchy governs communication pathways.

Laissez-faire leader. In this type of team structure, the leader delegates to the second most senior person of the team. The role of the leader is primarily monitoring.

Training. In the setting studied and some other settings, a member of a team (the fellow in the TRU) is being coached and trained to be the leader. The leader interacts mostly with the senior member in the training type of team structure. The leader interacts with other members of the team to help out the senior member.

Efficiency. Since the leader and the senior member are the most experienced members of the team, in certain conditions their direct involvement is necessary to ensure performance. In efficiency team structure, the communications to and from the leader are primarily from the senior members.

Discussions

An understanding of team structure can provide us with insight into the process by which team members work together. It also provides a basis for designing teams and communication technology support. One approach to studying team structure is to characterize communications among team members. In Tushman's (1979) study, for example, self-reported communications were separated into two categories: horizontal or peer-to-peer and vertical or supervisor-subordinate. However, this simplification of team structure may not be adequate to capture the variations of teams in work settings. Teams composed of expert specialties are sometimes called for complex tasks. These action teams (Sundstrom, De Meuse, & Futrell, 1990) may change their structure dynamically in response to stressful and unpredictable circumstances.

The proposed archetypes could be used as a way to measure and understand adaptation in team structure. For example, one may hypothesize about the adaptation of team structures based on the four archetypes. As teams gain experience working together, the leader may reduce his or her involvement with the rest of the team. As a result, the team will adapt the laissez-faire leader team structure. Under stress, the team may adopt the efficiency team structure, as the leader may be directly involved in team performance. Additionally, research on team structures can be based on codings of intra-team communication to represent the types of team structure adopted. In Analysis 2 below, team communications captured by audio-video recordings were coded to depict adaptation of team structures due to factors such as task urgency and team experience.

Analysis 2: Quantitative Analysis of Team Structures

Method

The intra-team communications captured on the videotapes were coded. Four communication parties were identified:

- Team leader: the surgical attending physician
- Senior member: the surgical fellow
- Junior members: the residents

- Collaborators: the rest of team members, consisting of anesthesia care providers, trauma nurses, and trauma technicians

The coding was performed by two trained research nurses. Each communication episode was coded in terms of initiator (the person who started the episode) and target (the addressee of the communication). In current analysis, only three initiators were considered: the team leader, the senior member, and the junior members. Therefore, there were nine possible communication linkages between individuals: three pairs (to and from) of connections among the leader, the senior member, and the junior members, and three single connections from these three parties to collaborators. For each case, the percentage of communication episodes along each of the nine linkages over the total number of communication episodes was calculated.

Furthermore, communication episodes originated from the team leader were coded into two types: requesting information and providing instruction.

The cases were aggregated along three dichotomies:

Distant leader: whether the team leader was on site with the patient (local) or in the communication room (distant)

Task urgency: whether the task of initial assessment and resuscitation was urgent or not. We used a measure of patient's injury status, Injury Severity Score (ISS), as a measure of task urgency. The patient in a case with an ISS score less than 5 was considered low in task urgency. A case with an ISS score equal to or higher than 5 was considered high in task urgency than a case with ISS score less than 5.

Team experience: whether the team was at the beginning of its tenure or at the end of its tenure. We defined the first 10 days of the month as the beginning and the last 10 days of the month as the end. We omitted the cases in the middle 10 days of the month.

Results

Out of the 55 field experiment sessions recorded, a total of 18 cases were selected for the current analysis. The remaining 37 sessions had deficits due to limitations in recording technology. OF the 18 cases, 10 were under distant condition, six were high task urgency, and nine were considered inexperienced team (first 10 days of the month). Due to small number of cases analyzed, no significance tests were performed. Figure 9.2 depicts the overall communication pattern for all 18 cases. The percentage numbers along the communication linkages were averages across all cases.

The impact of distance

Figure 9.3 summarizes the potential impact of this factor. When the leader was distant, there was an increase in the influence of the senior team member (the fellow). The hierarchical structure of the team becomes more prevalent, with increases in communication from the leader to the senior member, and from the senior member to the junior member. Reductions in communication from the leader to the junior member and to the collaborators were also observed.

The impact of task urgency

When the task urgency was high (i.e. the patient injury was more severe), there was an increase in the overall number of communication episodes from the team leader to the rest of the team, from an average of 9.2 episodes to an average of 15.8 episodes. It also appeared that when task urgency was high, the team leader was more involved with the senior member of the team (Figure 9.4). There was an increase of communication (approximately doubling) between the senior member and the team leader, and a reduction of communication from the leader to the junior member (Figure 9.5).

The impact of team experience

When the communication patterns were compared between the beginning of the team's tenure (Figure 9.6a) and the end of the team's tenure (Figure 9.6b), as the team was matured, the communication of the leader was greatly reduced, and the communication of the senior member was greatly increased. It appears that as teams became more experienced, the team leader was less involved with the rest of the team.

Leadership as reflected by content of communications

When each communication episode was examined in terms of the content of the communication, further details about team leadership emerged. Figure 9.7 illustrated the change in the type of communications from the leader to the rest of the team. When distant, the leaders tended to ask more questions and give less instructions compared to when the leaders were local. Similarly, when high task urgency cases were compared with low task urgency cases, there was also a change in leaders' communication content (Figure 9.8). When task urgency was high, the leaders tended to provide more instructions. When teams grew more experienced, the communications from the leaders tended to be questions as opposed to instructions (Figure 9.9).

Discussions

In team research, much has been learned and proposed about team functions. For example, the team function taxonomy proposed by Fleishman and Zaccaro (1992) contains categories of motivational functions and systems monitoring functions, which are often associated with leadership (Norhouse, 1997). In this sense, leadership in teams is intrinsically shared among their members. Several authors (e.g. Cox & Sims, 1996) have criticized simplistic views of team leadership in which the team leadership is framed as leadership by the team leader. However, how team leadership is shared in response to contingencies in the environment (e.g. task urgency), to team experience, and to spatial distance requires detailed empirical investigation.

In this chapter, one approach was proposed to understanding shared leadership through characterization of team structures and in particular through the adaptation of team structures to important factors. The analysis of data collected in a field experiment was focused on patterns of intra-team verbal communication as a way of uncovering team structures. The analysis is limited in focus and several other aspects of team communication were not addressed (such as non-verbal communication and detailed content analysis of all verbal exchanges). However, the analysis results provided initial support to the value of the approach to team leadership.

The preliminary set of team structure archetypes, although not completely new (Bolman, 1997), should provide a starting point for future research on team structures and leadership. The

archetypes have direct implications for design of telecommunication systems, too. The frequencies of intra-team verbal exchanges varied in anticipated trends in response to task urgency, team experience, and distance manipulation in the field experiment. The adaptation of team structures as uncovered by the communication analysis underscores the fluid and shared nature of team leadership, and the importance for a telecommunication system to accommodate the need of team leaders in changing the communication channels in response to contingencies.

It should be noted that the teams in the studied setting had two distinct goals: training and education of fellows and residents, and performing life-saving procedures. In many settings, such training and performing duality of goals is not uncommon (Kozlowski et al, 1996). Adaptation of team structure in opportunistic ways is necessary when different goals are to be pursued.

The proposed team structure approach to leadership, communication analysis methodology and the field experiment have a number of limitations. Many important issues exist in the study of distant leadership, such as trust and team development (Avolio, et al, 2001). Team structure as reflected by verbal communications provides a useful although limited approach to distant leadership. The communication analysis currently only examined the general patterns while detailed content analysis may provide more insight into leadership processes. Lastly, the field experiment, due to the constraints of the setting, was limited in terms of teams sampled and tasks studied. With increasing sophistication of technology, more expanded field experiments are possible to study teams in stressful, high-stakes, real environment.

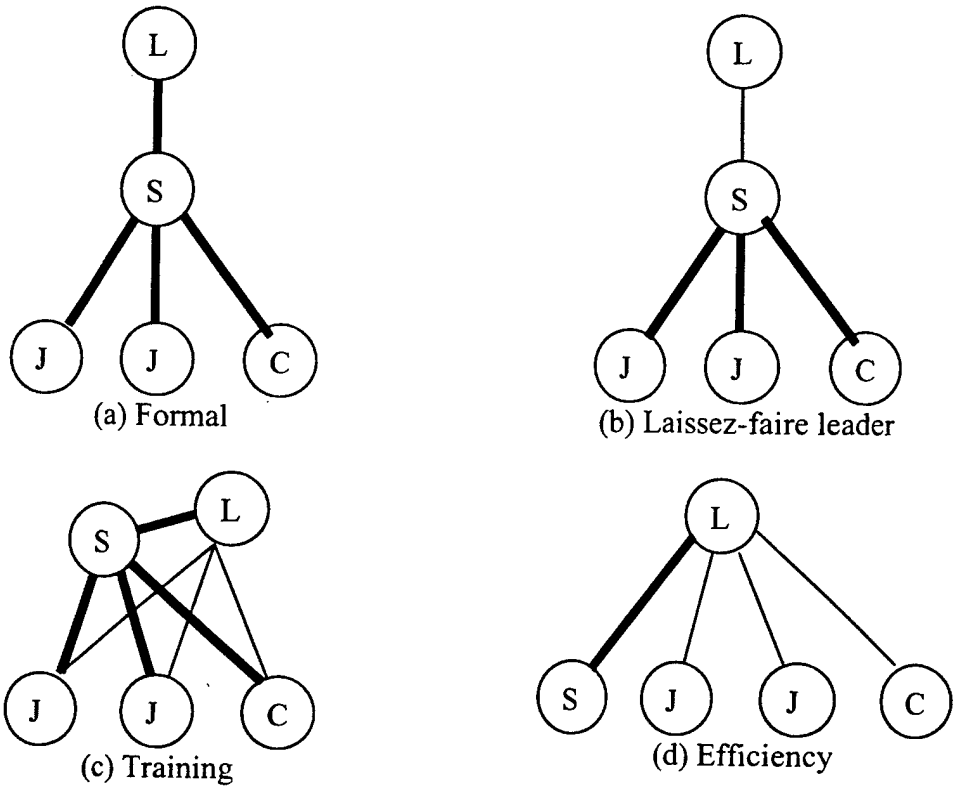


Figure 9.1: *Archetypes of team structures. The lines represent communication linkages. Line widths indicate different frequencies of communications. L= leader, S=senior member, J= junior member, C=collaborator.*

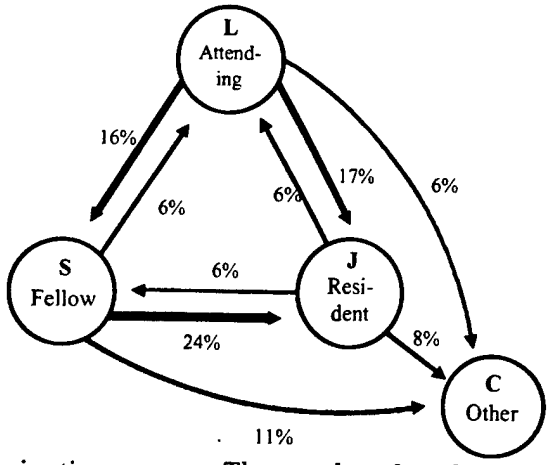


Figure 9.2: *Overall communication pattern. The numbers beside the arrows are the average percentages of communication episodes flowing along the corresponding arrows in proportion to the total number of episodes of a specific case. All numbers in the diagram add up to 100%. L= leader, S=senior member, J= junior member, C=collaborator.*

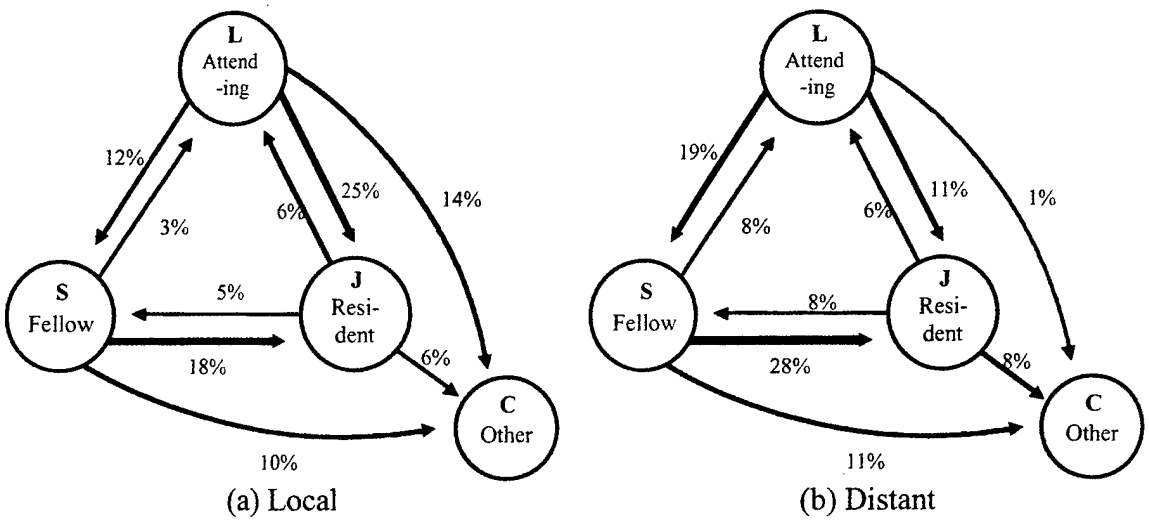


Figure 9.3: *The effects of team-leader location on communication. Left: Team leader located with team locally; Right: Team leader in a distant location, communicating with audio-video link. Numbers represent average percentage of communications across cases in each of the two conditions. L= leader, S=senior member, J= junior member, C=collaborator.*

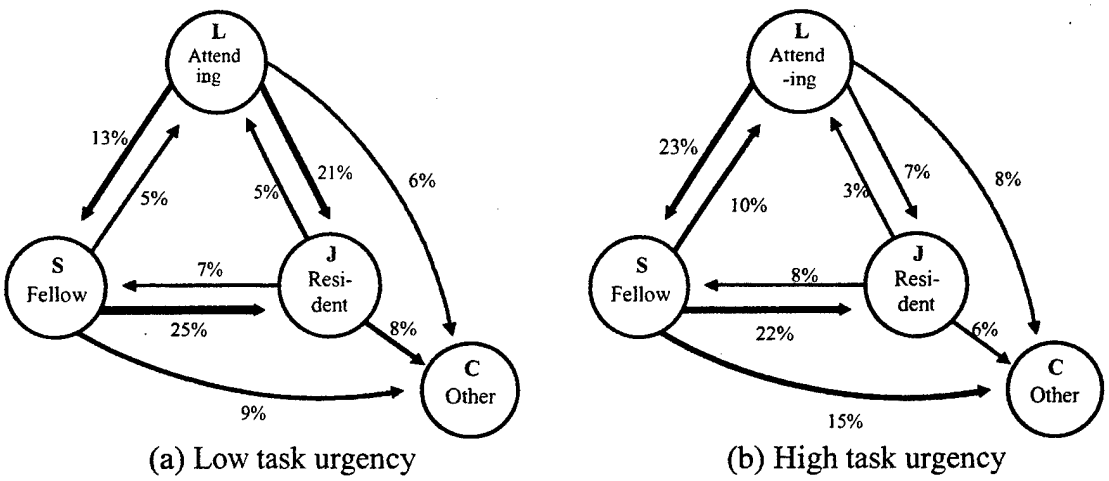


Figure 9.4: *The impact of task urgency on team structure. Left: low task urgency when patient injury severity scores (ISSs) were less or equal to 5. Right: high task urgency when ISSs were higher than 5. L= leader, S=senior member, J= junior member, C=collaborator.*

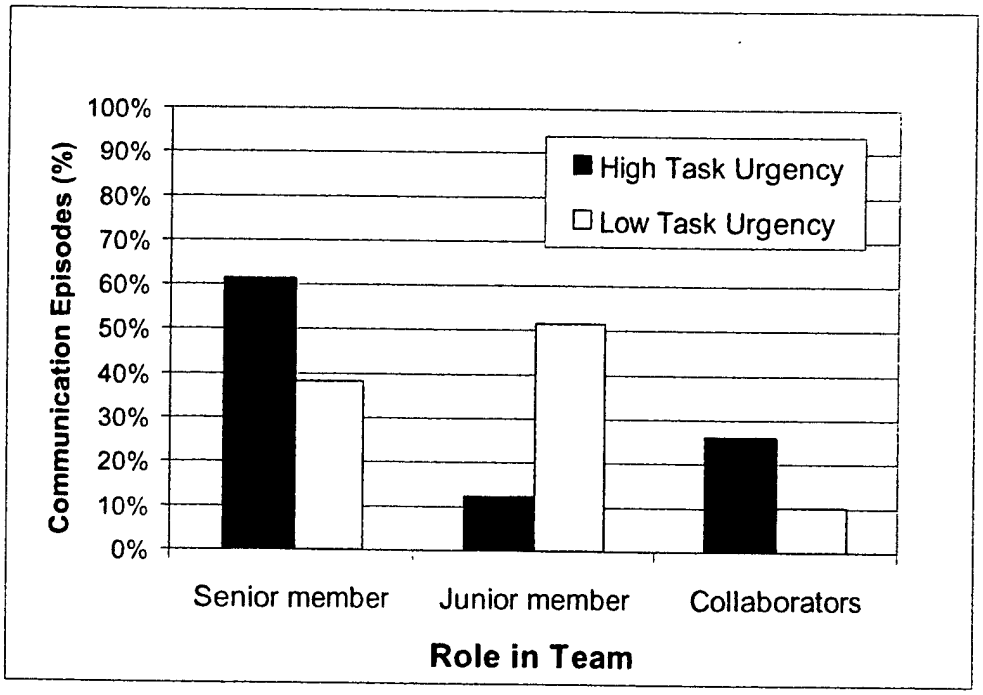


Figure 9.5: *The impact of task urgency on communication. Shown here are percentages of communication episodes between the team leader (attending surgeon) and the senior member (fellow), the junior member (resident), and collaborators.*

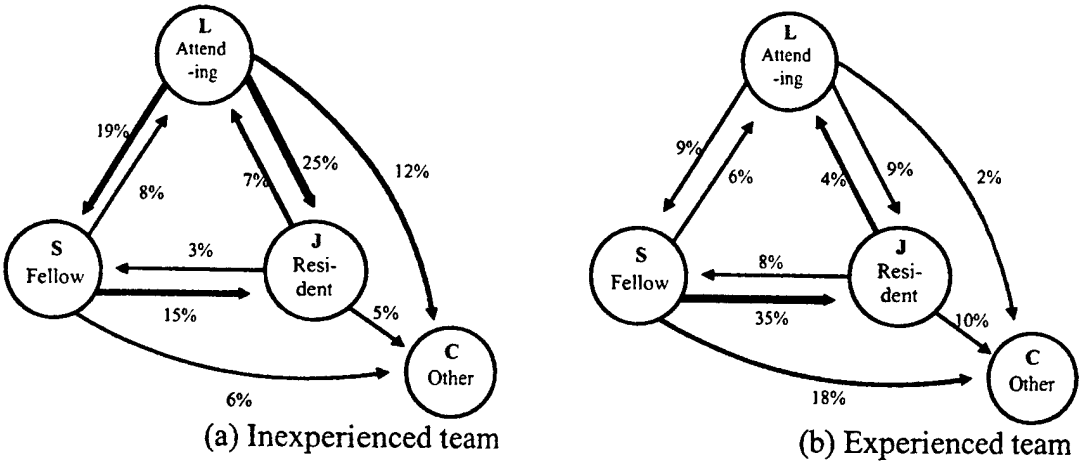


Figure 9.6: *The impact of team experience on communication. Left: teams were at the beginning of their tenure (the first 10 days of formation). Right: teams were at the end of their tenure (after 20 days of formation). L= leader, S=senior member, J= junior member, C=collaborator.*

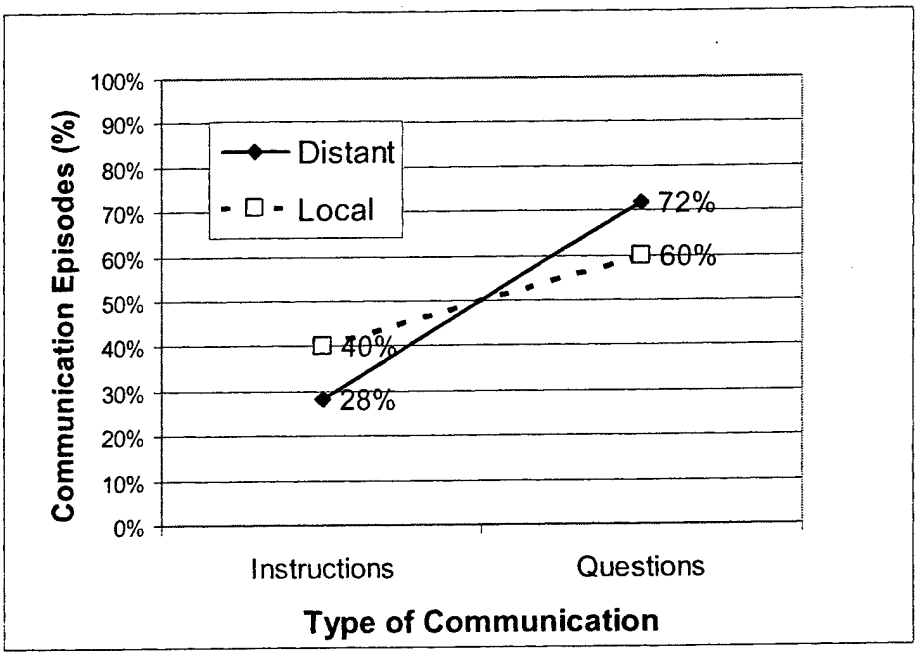


Figure 9.7: *Content of leader(attending surgeon) communications in distant and local condition. Shown here were the averages of percentages of communication episodes in two categories: instructions and questions under two conditions.*

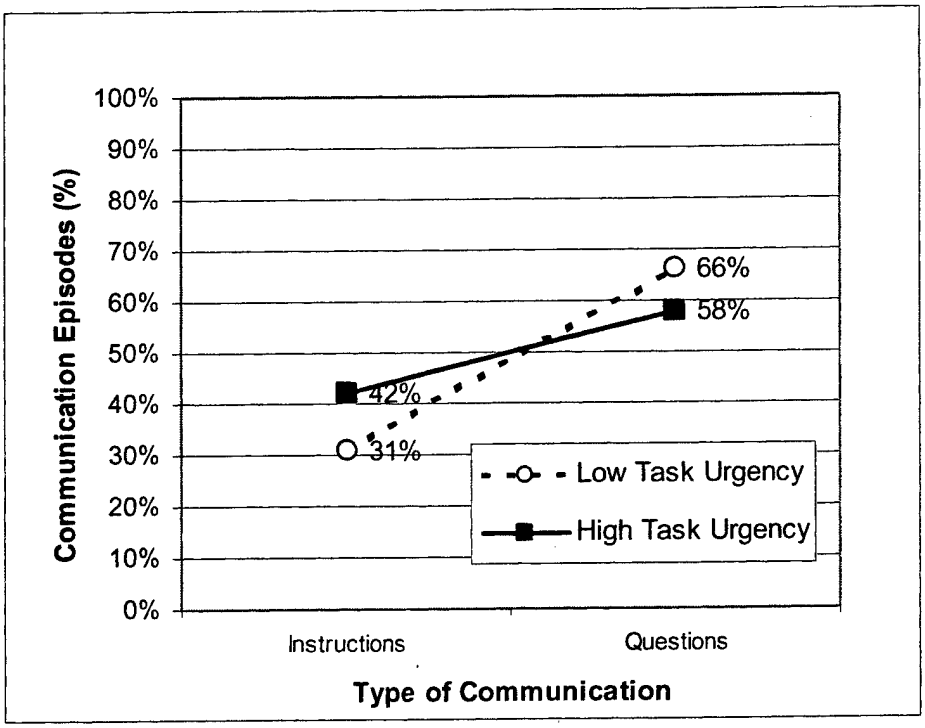


Figure 9.8: *Impact of task urgency on communication content. When task urgency was high, there was an increase of instructions from the leader.*

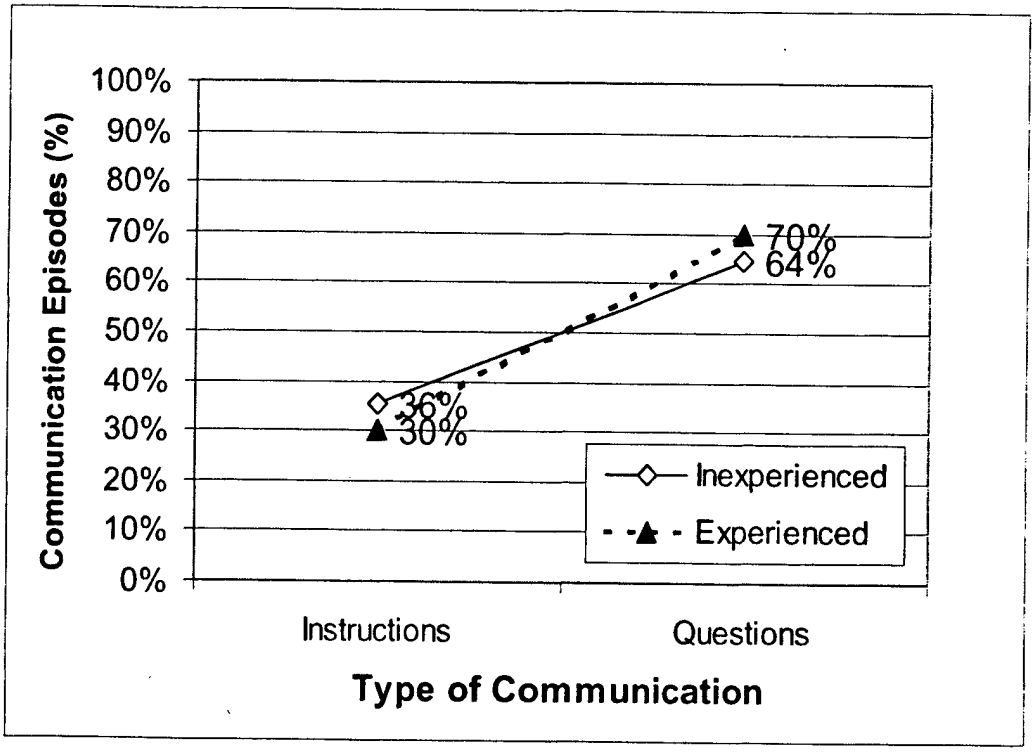


Figure 9.9: *The impact of team experience on leader's (attending surgeon's) communication content.*

Chapter 10. Study V. In-Depth Interview Study

The purpose of Study V was to clarify and extend many of the findings from the previous studies through greater in-depth qualitative interviews with a large number of shock trauma personnel from more diverse leadership backgrounds.

Method

During the spring of 2002, we interviewed six attending surgeons (out of a total of 11 on staff), seven fellows (out of eight on staff), and ten residents. The interviews were confidential and lasted between 45 minutes and 1 and ½ hours. Our interview questions focused first on clarifying the leadership issues that emerged from prior observation and interviews including the identification of the leader during a trauma resuscitation, specific leadership behaviors, and the consequences of leadership for team effectiveness and patient care. In addition, we sought to extend our understanding based on findings from the video tape analysis, surveys, and quasi-experiment through questions about team dynamics, hierarchy, and distinguishing features of the TRU. After transcription of these interviews, we identified topics, issues, and perspectives that emerged across the interviews through a grounded theory qualitative coding procedure. We refined our list of topics, issues, and perspectives, developing the list of major themes and representative quotes reported below.

Results

Again, the goal of the current study was to understand how leadership occurs within action teams. As this research is exploratory and designed to provide the basis for theory-building regarding action team leadership, we first focused on several basic questions. Indeed these questions are the elementary building blocks of action team leadership, addressing the nature of team effectiveness in the TRU, the identity of the leader(s) in the TRU, and key leader functions within the TRU. While these issues are relatively basic, they are fundamental to developing a foundational theory. Once we had the answers to these basic questions, we then focused our second round of interviews on extending our findings and conceptualizations and building a rich theoretical model of the nature, dynamics, and effects of the action team leadership system within the TRU.

Team Effectiveness

When we asked interviewees to describe the outcomes of effective team performance within the TRU, they emphasized three criteria: (a) the quality of patient care; (b) efficiency in delivering patient care; and (c) learning. The quality of patient care is the ultimate criterion, as emphasized by these comments from our interviews:

A good job is certainly when a patient comes out better than when they came in.

A good patient outcome is always a good thing. But, obviously, patients don't always do well, even if you try really hard. If I can tell that people are being thoughtful about what they are doing, considering all the options, being very deliberate with their actions, and

being proactive and sensitive to the situation, then I consider that effective treatment, regardless of what the outcome is.

Efficiency is also important. Here, efficiency means doing things quickly and, perhaps more importantly, doing the right things so that steps in the treatment of the patient do not have to be repeated:

We always try to be organized and efficient in treating the patient. In general, the faster you do it, the better your treatment is going to be.

The right diagnosis is critical to all subsequent management and how you get the right diagnosis depends on gathering the right information, making the right guess, doing the right exam. If you're doing the wrong test, you're wasting time, no matter how quickly you do it. You've got to be looking for the right things, considering the right hypothesis, recommending the correct directions. Everything else is irrelevant, time-wasting, and possibly life-threatening.

I think a team is ineffective if we have to repeat tests. We shoot all the films and then we have to shoot them again, because no one thought it through the first time.

It's bad when we have a lot of "re-work." If you have to stick the guy seven times to get the IV started, that's bad.

Finally, because the TRU is part of a training hospital, learning – by residents and also fellows – is an important effectiveness criterion, as these comments suggest:

An effective fellow oversees the residents as they do their thing with the patient, and guides them and educates them and helps them with their decision making. Similarly, an effective attending oversees the fellow's management of the patient and educates and directs the fellow.

Learning is critical. The more you teach, the more your underlings learn and the more effective everyone is going to be. And then basically you become more efficient as far as the team goes.

Teaching is very important and having a leader – a fellow or an attending – who enjoys teaching can make a big difference in residents' morale and interest level.

This is a teaching center. One of your requirements is to educate. You have to remember that all the time. You have to do it in a fashion such that residents learn.

A dynamic tension is obvious here. Team members are most likely to learn if they assume responsibility for tasks that are new to them, or if leaders engage in teaching new behaviors during the care of the patient. However, these behaviors may lengthen the time it takes to treat the patient, potentially slowing the patient's recovery or increasing the likelihood of errors or repeated steps in the diagnosis and treatment of the patient. Interviewees noted:

There are certain times to teach and certain times not to teach. Real-time teaching is appropriate in selective situations where the patient is stable, where there's time to do it, and you've got everything else under control.

Learning is important, but you don't ever sacrifice effectiveness and efficiency based on learning if the patient's life is at stake.

Leader Identity

When we asked interviews the basic question, "During the initial treatment of patients in the bay, who is the leader?", interviewees varied in their responses. An attending answered, "The attending surgeon is the boss, hands down. Every decision has to be approved by the attending surgeon." A fellow responded, "If something goes wrong on your team, it's the fellow's fault no matter what -- even if it's the attending's decision. I'm the one who has to take the flack for it, so therefore I'm responsible. In that sense, the fellow is the leader." And a resident answered, "The leader is the resident who's been identified, prior to the patient arriving, and that person rotates for each patient." These findings mirror our survey results. In an open-ended question on the survey, we asked "When you think of the leader in the bay, whom do you think of?" Many respondents listed more than one position and each position – attending surgeon, fellow, resident, and even nurse -- was listed at least once.

Despite this variability in survey and interview responses, all of the interviewees acknowledged that a formal and quite explicit hierarchy runs from the attending surgeon, to the surgical fellow, to the resident assigned to be in charge of the patient. Individuals higher in the hierarchy have greater expert and legitimate power than individuals lower in the hierarchy. Thus, the attending has the authority or right to assume an active leadership role whenever he or she chooses to do so, usurping the fellow's (or the resident's) active leadership of the team. Similarly, the fellow has the authority or right to assume an active leadership role, usurping the residents' – but not the attending surgeon's – active leadership of the team. The following comments were typical:

When you have a more hands-off attending, the leader becomes the fellow in my experience. In more routine -- not critical -- cases, the resident is really the team leader.

The attending surgeon is the leader. Then, the fellow should be next in charge. Every patient has a resident. The resident's supposed to give orders, to tell other residents what to do. There's a kind of system of checks and balances among the residents, the fellow, and the attending. And the nurses speak up a lot.

In sum, there is no single individual who is the acknowledged leader in the initial treatment of emergency trauma patients. In stark contrast to the vast majority of the traditional leadership literature, which assumes that the identity of the leader is clear and explicit, no single leader (e.g., "Joe Smith") leads the treatment of trauma patients. Nor is leadership clearly entrusted in the occupants of a single role. While attending surgeons have the greatest expert and legitimate power within trauma care teams, they are by no means the sole leaders of these teams. Rather, leadership functions are shared by and shift among the occupants of three roles: the attending surgeons, the fellows, and the residents. Nurses, too, play a role – more subtle and indirect – in leading trauma teams. To a considerable extent, this fundamental finding shaped

our subsequent research, as we sought to understand how, why, and with what effects leadership functions were performed and shared by the "leadership system" of attending surgeon, fellow, and residents. Before turning to a closer examination of this leadership system, we consider the leadership functions performed by leaders within this system.

Leader Functions

We relied on and integrated our observations of trauma care teams, our initial interviews with trauma team members, and our survey results to gain a preliminary understanding of the primary functions performed by trauma team leaders. We concluded that leaders perform, more or less extensively and effectively, six key functions for the teams. They: (1) offer *strategic direction* for the team, providing a focus or game plan for the team; (2) *monitor* the team's performance, preventing or correcting errors and missteps in the treatment of the patient; (3) *teach* junior members of the team how to perform specific procedures and diagnoses, enhancing team members repertoire of skills and abilities; (4) provide *hands-on care* of the patient, ensuring or enhancing the quality or speed of patient care; (5) remain *calm and composed*, fostering a calm, composed atmosphere among team members; and (6) *praise* team members, providing positive feedback that enhances team members' learning and/or positive affect. During our second round of interviews, we presented this list of functions (or leader behaviors) to interviewees and asked for their comments and feedback. All of the respondents reported that our conclusions regarding leader functions were correct, although many respondents commented that praise for team members was rare. We offer the following quotations from the interviews to clarify the nature of the six functions:

> *It's important to develop a plan and stick with it. It's very destructive to the team as a whole, to the success of taking care of the patient, to constantly change the plan unless it's some obvious situation that just warrants that you stop it and take another course of action. Decisiveness in carrying out your plan is important, whether in some cases you are wrong or right.* (Strategic direction)

> *If the patient is stable, I try to walk away but keep an eye on the residents. You've got to be sure that the residents are not doing something crazy because you can have complications.* (Monitoring)

> *I think that this environment should be used as a teaching environment as much as possible. There's not always a lot of time to teach but I feel it's one of my jobs to teach medical students and young residents in hands-on skills, procedures, and also to try to teach them clinical decision making.* (Teaching)

> *Often the leader is the resident who is performing all the tasks and communicating with the fellow who's sort of standing back. If the patient isn't too severely injured, the person that has their hands on is the leader, so they're not only directing what happens but also actually performing those tasks.* (Hands-on)

> *Dr. A is always a calm presence and he tells people, "Don't yell, everyone has a job to do, watch out for sharp edges."* (Calm and composed)

I think that in order to be a successful leader in this environment, you need to provide a lot of encouragement because many of the courses of action are of a harsh nature. They involve harming another human being, hurting the patient. So, I think enforcing a positive encouragement type style is much better than being negative and tending to negatively reinforce your team members. (Praising)

Notably missing from this list of leadership functions is: (a) the articulation of a charismatic vision, perhaps the defining characteristic of visionary, charismatic, or transformational leadership (); and (b) the formation of a close, personal relationship between a leader and a subordinate, perhaps the defining characteristics of LMX leadership (). These "omissions" reflect, we believe, two critical facets of the trauma care setting. First, trauma team members work day and night to save the lives of their patients. There is little or no need for a leader to inspire or motivate team members; their basic task – saving lives – is intrinsically motivating and inspiring. Indeed, when we asked interviewees about leader behaviors typically associated with charismatic or transformational leadership, they were confused ("Like the Japanese companies where they get up in the morning and they all do calisthenics?"), or they were dismissive ("I think people here follow the leader because the leader is right so to speak, not because the leader is charismatic"), or they suggested there wasn't time for charismatic leadership ("It's difficult in the nitty-gritty of hands-on care to do that"). Second, the transitory nature of trauma care teams in this setting is such that individuals rarely form intense, personal supervisory-subordinate relationships.

The Distribution of Leader Functions Across Leaders in the Leadership System

Our interviews and observations revealed that leader functions differ across the three primary leaders of the trauma care teams. Ideally, most interviewees concurred, the *resident* in charge of the patient provides strategic direction to the team, provides hands-on care of the patient, and remains calm and composed. Ideally, the *fellow* monitors the team, teaches residents new skills and procedures as appropriate (given the urgency of the patient's condition), remains calm and composed, and praises team members as appropriate. And finally, the attending ideally monitors the fellow and the team, remains calm and composed, and praises as appropriate. A fellow provided this example:

This morning we had a case where our fellow was standing at the end of the bed with his arms folded, no gloves on, letting the residents do what they thought needed to be done, and stepping in when he thought that we needed to go in another direction. The attending was coming in and out of the room. He wasn't even there the whole time. He just made sure every once in a while that things were going the way that he thought they should. I thought that was very effective because the attending knew what was going on and the fellow wasn't trying to do everything himself. The residents had a chance to experience things for themselves and try to take control to some extent.

Thus, a widely shared goal within the trauma care center is to "delegate down," allowing the least experienced team members to assume a great deal of the responsibility for patient care. A fundamental proviso, of course, is that the responsibility for patient care should be delegated down so long as this in no way threatens the health and recovery of the patient. This requires, in part, a judgment call on the part of those who would delegate date. Accordingly, the extent to

which the responsibility for patient care is indeed delegated down depends, interviewees agreed, on: (a) differences among the attending surgeons and fellows; (b) the severity of the patient's injuries; (c) the workload within the trauma care center; and (d) the confidence that the more senior team members have in the more junior team members.

Individual differences. Interviewees noted that attending surgeons differed in their willingness to accede control to fellows and residents, and fellows differed in their willingness to accede control to residents. Some attending surgeons and fellows were content to simply monitor most admissions: others nearly always participated in hands-on treatment of the patient. The following comments were typical:

> *Attendings who like to be in control all the time will step in all the time and take over regardless of the severity of the cases.*
>
> *Some attendings and fellows are much more present than others. Some let their team do their thing whereas others are breathing down their necks.*
>
> *I think a factor is insecurity. A confident surgeon will allow the resident or fellow to do more because they know that they can get them out of it. A surgeon who is not that confident is afraid that it that person gets in trouble, they won't be able to get them out of it.*

The severity of the patient's injuries. A key factor in determining the extent to which attending surgeons and fellows intervene actively in patient care is the severity of the patient's injuries. If a fellow or attending deems the team unable to provide effective patient care, the fellow or attending will step in, assuming an active role in patient care by providing hands-on treatment of the patient or by issuing strategic directions. For example, interviewees commented:

> *If a patient comes in who is not very sick, I will stand back and watch. The fellow will carry on with the resident and do their thing. As the severity of the injury gets worse, you will see more of an intervention on my part.*
>
> *Typically, the way I do it is if the person is not at death or dying, I will let the resident act as the leader and make the decisions. When they forget something or miss something, I will add to that. When I forget or miss something, typically the attending will add to me.*

Workload and confidence in junior members of the team. When injuries stack up within the trauma care center, leaders have no recourse but to delegate down, as this interviewee explained:

> *If three patients arrive at once, the fellow's in charge of one, and the attending's in charge of another, so who's in charge of the next one? Then, you have to move your leadership roles down the hierarchy so the senior surgical resident takes the next one. You just have to say to that resident, "You have to run the team and if you need me, you've got to call me."*

Not surprisingly, attending surgeons and fellows are more comfortable in delegating down to less experienced members of the team if they are confident in these individuals' skills and judgment. Typically, the longer junior members of the team have worked in the trauma care center, the more confident team leaders are in their abilities:

Who assumes leadership depends in part on the comfort level between the fellow and the more senior resident. If the fellow and the attending trust the senior resident a lot, especially toward the end of the year, they will step back more and let the senior resident take control over the situation.

If a fellow has been here a while, I don't really need to watch over him like I'll watch over the fellow who's been here two days.

Thus, leadership flows dynamically and fluidly among the three key role players within the action team leadership system: the attending surgeon, the fellow, and the resident. Attending surgeons and fellows control the flow of leadership, choosing the leadership functions they wish to serve and, to a considerable extent, the leadership functions that other team members will serve. The attending surgeon's choices – to monitor closely or lightly, to provide no hands-on care or extensive hands-on care, to teach, praise, and provide strategic or to remain in the background – supercede the fellow's choices. But, in the absence of active intervention on the part of the attending surgeon, the fellow may make the same choice vis-à-vis the residents on the team, allowing residents more or less control in determining and carrying out patient care. Who performs which leadership functions thus varies within and between teams and within and between patients – indeed, in some cases, from moment to moment. In one 15 minute interval, we observed one attending surgeon approach a team already at work in treating a patient who had arrived two minutes earlier. The attending came within three feet of the patient, observed the team, then sat down approximately 10 feet from the foot of the bed, slouching, glancing up at the team periodically, writing notes, and drinking a soda. When the patient moaned audibly, the attending stood up, donned gloves, joined the team at the patient's bedside for perhaps one or two minutes of active strategic direction and hands-on care, then retreated to his chair, removing his gloves to finish his notes and soda and to monitor the team from a distance. In short, the attending surgeon monitored and delegated care of the patient to the team , then assumed a more active leadership role, and then receded to again monitor and delegate patient care to the team – all in the space of a few minutes.

Team Member Responses to the Flow of Leadership

The leadership system we have described differs markedly from the leadership models and even the team leadership models within the organizational literature. Within the trauma care teams, leadership does not reside within a single individual. Leadership flows among individuals, controlled by the decisions of those higher in the hierarchy. Thus, lower level leaders exert influence to the extent that higher level leaders allow them to do so and lose influence whenever higher level leaders assume control. Such a system could easily cause confusion or friction, but we observed and heard remarkably little confusion, conflict, or irritation among the three leaders of this system. Interviewees' comments suggest that they are comfortable with the current system because it is the surgical norm, because it meets patients' needs, and because residents and fellows, at least, are on their way up and out. While attending surgeons are on-going, permanent employees of the trauma center, fellows and residents are rotating through on their way to assuming higher positions with surgical or medical hierarchies. Fellows' and residents' working conditions are only temporary.

At least at the training level, these roles are pretty well known. Residents recognize that they are physicians in training and the fellows also recognize that they're physicians in

training too. But, they recognize that they've finished the training that the residents are getting now. Everybody knows their position

When I step in to get involved because things are going sour with the patient, people know that they need help, so they kind of invite it. They are almost glad you are getting involved. You are kind of saving their butt.

Sometimes there is some friction between an attending and a fellow, but it's not too bad because usually you just have to wait until the end of the month or the week because the attendings change every week. So, you just say, "What the hell..." You just get by, so you don't have too much of a headache.

Usually, we all interact very smoothly with each other. I think with me and the attendings, I will be fairly vocal about my opinion. But, if I disagree with them once, I tend not to push it beyond that -- out of respect. It's their license, not mine.

The Nurses' Role: Supporting the Leadership System

When we asked interviewees what was distinctive about the trauma care center, they invariably mentioned the caliber and status of the nursing staff. Nurses within the trauma care center have unusually expertise, experience, autonomy, and influence. They play a vital role in monitoring residents' treatment of the patients and provide subtle yet important strategic guidance to the residents, when the attending surgeon and fellow are unavailable to do so. In this sense, they provide key leadership function both directly (to the residents) and indirectly (in notifying fellows and attending surgeons of potential problems). While the nurses sometimes clash with the residents, they have great support from the fellows and the attending surgeons:

This place is very nurse-strong. When the founder set up the place, he basically told the nurses, "It's hard to find a good nurse. You can dump a doctor and get another one in here very quickly, but it is hard to find a nurse and keep her." The nurses here are empowered in every sense. They come across like that and let you know that.

In our institution, nurses have a lot of freedom. There's sort of like a blank check order form that as the attending physician, I'll sign and assume the responsibility for their actions, saying that this would have been an order of mine.

The nurses are extremely knowledgeable and extremely intelligent. If a resident is screwing up a patient, the nurses will come and tell me because I'm a fellow. You know, they say, "The baby over there is about to drop a lung. I need to come tell an adult. You need to go over there and help them." I tell the residents, "Your nurse is your best friend. And the day you understand that and the day you accept that and respect that will be the day that you do well here."

In general, although they will never admit it, our TRU nurses really enjoy working in a teaching environment. They enjoy in an informal way being very important in educating the residents, otherwise they wouldn't be here. The nurses who stay and are really popular are really good at leading the resident without making an issue of it.

Discussion

There was no single leader of the trauma teams we studied. There wasn't even one single role that consistently performed the leadership of the team. There was a leadership hierarchy in which one individual had the expert power and authority to assume a dominant leadership role, but he/she may or may not choose to do so. This finding challenges the fundamental assumption made by most leadership studies and theories that there is a single leader (or no leader at all) within each unit.

The members of the leadership system were highly interdependent, adjusting the extent to which they provide leadership as a function of each other's behavior, their confidence in themselves, each other, and the team as a whole, the nature of the patient's injuries, and the workload within the trauma care unit. This was a highly interdependent, contingent work *and leadership* setting. Leaders constantly adjusted and adapted their leadership behaviors vis-à-vis the team.

Our findings highlight the importance of time in the studied context. One cannot make sense of team leadership in this context without considering time. In contrast, most leadership theories seem to ignore time altogether. Action team members work together for short periods of time. The work is time-pressured. Patients arrive at unpredictable rates of time and at unpredictable times. Action teams change in composition over time – from hour to hour, day to day, month to month. Action team members – residents, attendings, and nurses – work in the trauma care unit for differing lengths of time (a month, a few months, or semi-permanently). The trauma care unit must be staffed continuously over time – 24 hours a day, 7 days a week, 365 days a year. The leadership system in the trauma care unit is designed to accommodate all of these "time constraints."

The leadership system presents a fascinating paradox of rigidity and flexibility. The hierarchy among the leaders is rigid and yet the leadership system is highly flexible, adjusting easily, quickly, and with minimal conflict or resistance to meet the changing and unpredictable demands of patient care delivered by teams of changing composition and often varying (and unknown) expertise.

Few leadership theories address delegation. Delegation is critical in the studied setting. Participation in decision-making is minimal; there isn't time for that. But, delegation is pervasive and, once again, fluid. Leaders in this setting repeatedly delegate responsibility, reclaim authority, then delegate again.

Chapter 11. Qualitative analysis of video recorded performance: Summary of Corpus of Cases

Since their inception, video recordings have attracted attention of researchers and educators (Tardiff, Redfield, & Koran, 1978; Dowrick & Biggs, 1883; Hoyt, et al, 1988). In the studies reported by Hoyt et al (1988), for example, more than 2500 trauma resuscitation cases were video taped and reviewed over three years for team performance during initial assessment and resuscitation of trauma patients. Although not a substitute of direct observations (see a discussion in Maxwell & Pringle, 1983), video recording allows time-shifted analysis so that recorded performance can be reviewed at a convenient time. The recorded performance can be repeatedly examined in a fine-grain analysis process.

Significant efforts have been on the abstraction of performance related data from video recordings. The abstraction process can be simplified with the help of a task template, with the intention of detecting variations of task sequences and timing of events. The inherent timeline of abstracted video data, such as verbal and non-verbal interactions, provides a basis for sequential data analysis (Sanderson & Fisher, 1994) of timecoded events and activities. Another approach to video analysis is through summary ratings of subject matter experts after reviewing video recordings.

A significant line of research activities is associated with theory building (e.g. Xiao & Mackenzie, 1998). The central thrust of this type of research is to make statements about observed behavioral patterns, with the intention for informing establishment of theories and hypotheses. Video recording can potentially be a rich source of data for such research, since when comparing to observational notes and audio recording, video recording capture much of the richness of human interactions and of the context in which activities are studied.

Grounded theory approach (Glaser & Strauss, 1967; Strauss & Corbin, 1990) is a qualitative research methodology that emphasizes the iterative nature of discovery, especially in the study of human performance. It is well suited for research whose aim is to uncover major categories of behavior patterns (Albrecht, 1985). In the area of leadership research, there has been call for the use of grounded theory approach to lay a foundation on the basic nature of leadership (e.g. Parry, 1998). The essence of grounded theory approach is generative as opposed to confirmative. Because of this nature, it is applicable to research on those phenomena that are not well defined. Grounded theory approach, as outlined by Strauss & Corbin (1990), provides procedural guidance on a qualitative analytic methodology. The procedure is driven by a general research question and details three major steps in data analysis. The first is the so-called open coding. In open coding, concepts are formulated to encode observed data into categories. The second step, axial coding, is to develop causal relationships that link conditions and contexts with actions. The third step is to establish a conditional matrix, which is an analytic grid to include wide a range of conditions. In their original form, grounded theory approach relies on memos and note from direct observations and interviews.

In this chapter, we will first describe the research paradigm for studying team leadership and then describe an inductive process of video analysis based on grounded theory. In this

process, the types of observed leadership behavior and the types of situations that team leaders faced were categorized.

Video analysis methodology

Based on the literature, our video analysis was driven by two questions: Who provides leadership in a team? What are the roles of leaders in a team?

Analysis process. A small group of research analysts (two nurses familiar with trauma care in general and the trauma center in particular and two human factors specialists) participated in the video analysis. A three-stage process was used in the analysis of video. In the first stage, segments were selected from the video recorded cases if they contained occurrences of team verbal and non-verbal interactions relating to leadership. In the second stage, these segments were abstracted to fill in the blank of the following sentences: "a leader did ____ when the task situation was ____". The results of the second stage were lists of case segment descriptions, along with timecodes to identify the context in which the segment occurred, in spreadsheets. In the third stage, taxonomies that describe and classify leader actions and their relation to task situations were developed through a recursive process.

Results

A total of 152 segments (typically 10-30 seconds long) were identified and extracted from a total of 18 cases. Table 11.1 shows the example of the results of abstraction on leadership behavior. Through an iterative process, six types of leadership functions emerged. We will describe these functions below.

Strategic planning

Strategic planning was used to allocate resources and efforts to achieve a given goal, or to establish or change a given goal. Due to the well-rehearsed and protocol-driven nature of many trauma resuscitations, strategic planning was not observed in every case. In the cases where strategic planning took place, it was often precipitated by a lack of resources. Specifically, when there was a shortage of time due to the criticality of the patient; a shortage of human resources due to high demands of patient care; shortages in equipment availability, leading to the need for alternative strategies for treatment and a need to coordinate teamwork; or a lack of knowledge, due to unusual case presentation and uncertainty regarding patient diagnosis.

A second type of strategic planning was triggered by the planning process that often follows a specific decision point being reached, or the introduction of significant new information into the decision process. Tasks or events leading to planning included the achievement of major task landmarks (such as the end of initial stabilization and assessment, the so-called primary or secondary surveys, or the conclusion of a diagnostic procedure such as imaging studies or reporting the results of lab-work). While the reaching a decision point or the arrival of the information are precursors to this type of strategic planning, this second type of planning was more closely related to formalizing a plan rather than developing or modifying a plan.

Reporting plans

Team leadership maintained a unified plan for the team. One way of maintaining the team's unity was through regular reporting of plans. Reporting was observed in response to the completion of sub-tasks, such as completion of primary or secondary survey. Reporting plans can be distinguished from strategic planning by the number of parties involved. Strategic planning is triggered by uncertainty and typically involves multiple actors iteratively developing a plan. In contrast, reporting of plans can be triggered by some of the same events (e.g. decision points, etc); in reporting there is less uncertainty, less iteration, and typically a single actor reporting up to a supervisor (e.g. resident report to fellow or fellow report to attending).

Critique of plan

When a reported plan is perceived by the attending surgeon to be inadequate, the attending will often correct or "critique" a specific aspect of the plan. Critiques are triggered by completion of a report or by the initiation of a plan of action. In contrast to strategic planning, critiques are triggered in response to weaknesses perceived in the plan by supervisors. While strategic planning often takes place during high-paced stressful time, critiques occur in lower-stress situations in which there is sufficient time to examine a plan and use the plan's evaluation as a learning opportunity.

Coaching

Critiques of plan take place at the conclusion of a planning phase or at the start of a plan's implementation. Coaching is similar in that it is often a learning opportunity. However, it is triggered differently. It typically is triggered during performance of a task, rather than during planning before a task commences. Coaching activities arise in response to a perceived lack of knowledge or strategy on the part of the operator, due to inexperience or due to the novelty of a situation. Coaching was triggered by performance lags (slow completion of a process was coached to speed up or change strategy), or errors in performance (omission of steps in the primary or secondary survey were pointed out). For example, attending surgeons and fellows coached residents who were performing abdominal sonograms ("FAST" exams) for the first time during the trauma admissions. When differences in team-member skill or knowledge interfere with team performance, coaching often occurs. In high-stress or time pressure situations, coaching can be replaced by team-structure modification, where a more experienced team member will assume control of the task in question. Attending surgeons were observed to take direct leadership (as opposed to supervision) of an admission when there were errors or deficits in performance and insufficient time for coaching.

Maintaining Awareness

Team functioning is sometimes facilitated by actions that maintain team awareness of status and planed activities. Efforts to maintain awareness were observed most frequently following the completion of tasks that provides information that could contribute to a diagnosis. One prime example of this is the verbalization of the results of airway management, which is instituted as part of the airway management protocol. Care providers listen to the chest and stomach after intubation of the patient, and announce, "breath sounds on the right; breath sounds on the left; breath sounds equal; and no breath sounds in the stomach." In contrast to "reporting" which typically communicates the formation of a plan to a supervisor, maintaining awareness announces current status to the team as a whole, or communicates the immediate goals of the

team to the whole team. Announcing a plan to the team, as noted above, also functioned to unify the team and can be considered as an act that helped maintain team awareness.

One should note that visible actions by a team member, such as removing the cervical collar, are clearly visible and therefore function to maintain awareness. These types of actions are not generally announced, and cannot be classified specifically as efforts to maintain awareness. They are generally not noted in the data.

Information requests

The converse of declarations to maintain awareness is request for information. Active pursuit of information to form a strategic plan, or to maintain awareness was observed in team leaders. Information requests were precipitated in many of the same conditions that precipitated reporting of a plan, such as the completion of a subtask in the admission process. Requests were additionally observed when a new member arrived or directed attention to the admission, such as the arrival of an attending surgeon after the admission started. Information is requested to regarding patient status (wound condition, history, status of breath sounds, etc.) were common.

When portions of plan are completed, relevant information is requested about team activities (e.g. who is maintaining cricoid pressure) or patient condition (e.g. what is oxygen saturation levels and whether there is intravenous access). Information requests were often precipitated at times when a plan is or should be formed. If a report was not forthcoming, information was requested about plans or strategies (findings, diagnosis, summary of surveys).

The grounded theory approach also allowed us to examine the concurrent conditions under which the observed team leadership was observed and we were able to articulate that relationship in a matrix format (Table 11.2).

It should be noted that any of the leadership activities could take place under nearly any condition. However, specific leadership behaviors are more commonly observed in certain conditions. The matrix above could easily indicate activity in each cell. However, the current marking scheme indicates the situations in which specific leadership behaviors are most likely to occur.

Protocol Normal: The admission process in the TRU is largely based on the ATLS and other standard protocols. When the steps in the protocols are followed, and no significant deviations or unexpected results arise, the protocol can be described as "normal." Normal protocol may include diagnostic examinations such as the abdominal sonogram "FAST" exam, primary survey showing no serious anomaly, and the patient presenting as stable.
Leadership Functions: As part of standardized procedures, team members maintain team awareness of actions, such as calling out vital signs or findings during the primary and secondary survey. At the conclusion of the protocol, a plan is formed, which is communicated to the team.

Task Completed: Certain discreet subtasks in the admission process can be considered as independent tasks, and the completion of those subtasks precipitates a report of the conclusion of the activity. For example, when the chest is auscultated, the person listening to the chest is expected to announce the results of the ascultation loudly to the team.

Leadership Functions: These reports serve to maintain team awareness of status, and if the results reveal an anomaly or indication requiring follow-up, the report may include a statement of plan indicating a strategy for treatment of the finding. For example, [in case 17] when the FAST exam and examination of the patient neck were completed, the resident reported results ("no signs of internal bleeding and neck is clear") to the fellow, and the fellow states to the resident that the patient now needs to be "rolled" to examine the patient's back, according to the standard plan of care.

New information available: The results of tests diagnostic procedures may reveal information pertinent to the procedure being preformed. For example, [in case 49] the diagnostic x-ray films of the patient were available for review during the admission process.
Leadership Functions: When such new information becomes available, it may precipitate a report of the relevant information. That information may also trigger a new line of inquiry, which in turn may initiate requests for additional information. In the case of the x-ray films being available, the follow-up consisted of requests for information by the attending surgeon regarding intravenous access and results of auscultation of the chest for breath sounds.

Plan formed: When sufficient evidence has accrued, a plan of treatment is formed for the patient. A plan can be formed because of mounting evidence, or a plan can be formed because a differential diagnosis is needed at a given time. In either case, a working plan is always formed during each admission.
Leadership Functions: Following the initial formation of the plan, the plan may be communicated to members of the team, and their input sought. For example, a surgical resident may form a treatment plan, and then communicate this tentative plan to the surgical fellow, who will may discuss and critique the plan from strategic and practical perspectives. [In case 6,] the fellow announces to the team that there was a positive FAST exam, indicating internal bleeding, and consults with the attending surgeon regarding taking the patient for Computer Tomography (CT) imaging and possibly the "Angio" lab.

Change in Status: During the course of a patient admission, the status of a stable patient may deteriorate, or an unstable patient's status may suddenly change in a dramatic manner. One of the most dramatic of these changes would be when the patient goes into cardiac arrest during the admission.
Leadership Functions: This type of change in patient status may necessitate a plan to address the change, precipitating strategic planning. Such a change is often communicated to the group in order to maintain the team's awareness of the current situation. Our experimental protocol did not record any cases in which a patient went into cardiac arrest during recording. However, when an arrest occurs, the treatment plan is superceded by a "Code Red" protocol for resuscitation, which is often announced on the public address system, and which focuses on re-starting the patient's heart.

Error made: Education of residents in teaching hospitals is often in the form of hands-on training through guided trial and error, or coaching. In such situations, a junior team member, such as a surgical resident, may make a strategic or procedural error. In one case [case 21], the resident orders a set of blood samples sent for lab tests that were questionable in relevance.

Leadership Functions: The supervising caregivers, such as the fellow or attending surgeon, have different options available in response to an observed error. Typically, an error by a junior member will result in request for information clarifying the erroneous action, its precedents and implications. Additionally the plans or actions associated with the error are critiqued. If there is little or no task urgency, the leader may also opt to coach the junior team member to correct the problem and learn from the mistake. In the case of the blood samples being sent for questionable lab tests, the attending engages the resident in a conversation about what labs were being sent and why, and leading to the conclusion that many of the tests were not needed.

Resources inadequate: During patient admissions, staffing or equipment may be required at particular levels to cope with the demands of the admission. Due to the availability of staff or equipment, or due to the extreme demands of a particular case, the demands of resources may exceed the available resources dedicated to the task. In case 6, the patient could not be taken for a CT scan immediately, because it would be 10 minutes until facilities were available.
Leadership Functions: In these situations, a number of leadership activities can be employed to remedy this inadequacy. The coping strategies themselves are often discussed in strategic planning activities. Information about the availability of resources can be requested. If the level of urgency permits, a leader may coach a junior team member on ways to cope with the particular inadequacy of resources. In the case of the limited CT scanning resources, the attending surgeon informed the surgical fellow and resident of the scheduling problem with the CT scanning, and discussed timing the treatment of the patient according to these constraints.

Novel Situation. Many patient admission processes are routine, with simple and straight-forward treatment following normal protocol. However, on occasion, novel situations arise due to the combination of symptoms, physiological problems, mechanisms of injury, or limitations in the environment of care. Case 3 included a positive FAST exam, indicating internal bleeding, for a pregnant woman suffering from a stab wound.
Leadership Functions: In novel situations, strategic planning is often necessary, and leaders maintain team awareness of the situation because standard protocols may not apply to the novel situation. Depending on the urgency of the situation, novel situations may be used as valuable coaching opportunities for junior team members to experience a novel event or coping strategy. In the case of the pregnant woman with the stab wound, the attending surgeon confers with the fellow and discusses the plan for a diagnostic peritoneal lavage in these special circumstances of a pregnancy. The attending coaches the fellow to consult with the special protocol in the computer system in cases such as this.

Membership change: In the dynamic team structure of a trauma admission them, membership in the treatment team is often changing and of a fluid nature. Team members may leave an active admission to join a new admission, or join an ongoing admission when another admission ends.
Leadership Functions: Two leadership activities often are typical in such situations. First, when new members arrive, there is often an effort to maintain awareness by announcing arrival or departure, providing status updates, or requesting information about the case. For example, a standard practice observed in almost every case recorded is for the X-ray technician to announce "X-ray standing by" upon arrival to an active admission, often well after the admission begins. The second leadership activity involves getting a situation update, in which the new member may request information.

Leadership change: The attending surgeon and fellow may not be present at all times of a patient admission. The attending surgeon may divide attention between two simultaneous patient admissions, for example. [Our experimental protocol precluded recording simultaneous admissions, so no cases were recorded as examples.] Similar issues arise if an attending surgeon's attention is diverted from an active admission by an interruption. In such cases, when a senior member enters or re-enters an admission in progress, he or she sometimes assumes the mantle of leadership from the existing team if such an action is deemed necessary.
Leadership Functions: In cases where leadership as assumed by an attending surgeon or surgical fellow, the senior leader will often take a report of the current status from the outgoing leader, and may request additional information in order to gain knowledge of the situation at hand, a pattern seen in many of the observed cases.

Discussions

An understanding of team leadership functions can provide us with insight into the process by which team members work together. Potentially presence of leadership functions could be used in the construction of team leadership measures. The current state of knowledge warrants exploratory investigation on the types of team leadership functions occurring, so that further targeted field and laboratory studies can be designed.

What is the significance of the findings from the video review of corpus of cases? Leadership research has traditionally been carried out with survey methods, and few research has been reported using observational techniques. Video recordings provide several analytical advantages in assisting observational techniques. First, the fleeting nature of events is captured on video and can be reviewed repeatedly and in detail. Second, multiple analysts can examine the same performance for consensus and reliability check. The findings from the qualitative analysis will be discussed in the following two areas: (a) a comparison of the leadership functions observed in the current analysis with those uncovered through interviews and surveys reported in Chapters 4 and 6, and (b) recommendations for development of observational, objective measures of team leadership.

Leadership Functions

Through in-depth interviews with the team members at the studied center (Chapter 3), we suggested that leadership functions were performed by a number of team members, for both types of functions: monitoring and action. Specific functions reported included formulating a game plan, delegating tasks, teaching team members, monitoring team member performance, and providing encouragement and rewards for successful performance. In contrast with literature, little evidence from the interviews supported the presence of charismatic or transformational behaviors. Based on a review of literature and the interviews, we formulated a list of leadership behaviors and used survey methodology to determine a subset that were perceived as most frequently occurring and having most impact (Chapter 6). The results of the survey study suggested six leadership behaviors were identified: strategic direction, hands-on treatment, teaching, monitoring, praising, and remaining calm and composed.

The list of leadership functions identified through the qualitative analysis of corpus of cases did not match the six behaviors identified through the survey study. Note that the list of leadership functions reported in this chapter were through neutral observers who analyzed video

recordings, whereas the six behaviors were the results of self-reported answers to questions in a survey study. Note also that in the survey study, the focus was on specific behaviors, such as "remaining calm and composed", whereas in the video analysis the focus was on the functions that team leadership was to perform. The comparison between the results from the two studies is shown below.

Observed	*Reported*
Strategic planning	Providing strategic direction
Coaching	Teaching
Maintaining awareness	Monitoring
Information requests	NA
Reporting plans	NA
Critique of plans	NA
NA	Remain calm and composed
NA	Hands on leadership
NA	Praising

Three of the leadership functions noted in the video analysis corresponded to the leadership behaviors in the survey study, where the rest did not match. Some of the behaviors were not noted in the analysis of video recordings.

The three functions not in the reported column were "Information requests", "requesting plans", and "critique of plans". These were very specific leadership functions directly observable. It was difficult to judge "hands-on leadership", which was reported but not noted in the video analysis. Finally, "praising" may occur before or after the recorded period and was not observed in the analyzed corpus of cases.

In a related study, also conducted at the studied center, Yun et al. (2003) reported the results of a survey study on team leadership in trauma settings, using a set of varying scenarios. The main finding was that the respondents preferred adaptive leadership functions, changing leadership functions depending on task conditions. The leadership functions in that study were represented by two types of leadership styles: empowering and direct. In empowering leadership, the senior members of a trauma team delegate responsibilities to junior members, whereas by contrast, direct leadership would entail that the senior members directly involve themselves in patient care. The current grounded theory approach identified a list of leadership functions that embodied two leadership styles. For example, critiquing plans and coaching are associated with empowering leadership style which engages the supervised team members in active decision making, whereas information request are associated with direct leadership style in which the supervisor controls procedures and decisions more closely. Table 11.2 can be viewed as a substantiation of the idea of adaptive leadership style.

It is important to note that the video analysis techniques based on the grounded-theory approach used in the current chapter were different from the ones used in critical procedure analysis (CPA; reported in Chapter 8). With CPA, the neutral observers provided ratings to a given set of leadership behaviors, whereas in the video analysis here, the analysts were not constrained on the types of behavior observed.

Measures of team leadership

Measures of observable leadership behaviors can potentially be valuable in selection, training, and evaluation of team leaders. The leadership functions reported here may provide an approach to the development of observable leadership behaviors, since the leadership functions reported here were based directly on observable behaviors.

We suggest two potential ways of such development efforts. One way is to develop a checklist of leadership behaviors, such as the ones reported here. Neutral observers could use the checklist to score leadership during intense situations. In dynamic settings, however, it may be infeasible to provide a single score over the course of time as situations change and the demand for leadership functions may also change. A second way is to develop a checklist so that it can be used to score a number of times over the course of team activities. Such checklist approach based on observable leadership behaviors can potentially be applied with multiple raters and thus be assessed in terms reliability.

As mentioned earlier, in highly dynamic settings with high outcome stakes, teams often consist of highly skilled team members. In these teams it may be important to focus on leadership functions as opposed to the behavior of *the* team leader, since multiple people in a team may performance team leadership. As a result, the approach suggested here can remedy some of the shortcomings of self-reports while providing measures of team leadership, regardless who may perform leadership functions.

In summary, grounded theory approach can be an effective method in video analysis, especially when research questions are not well-defined and the phenomena are poorly understood. Compared to traditional methodology in applying grounded theory approach, video recording allows multiple analysts to examine the same recorded performance for consensus. Additionally, it is also possible to re-examine the same segment after initial categories have been developed.

Table 11.1: *An example segment from the corpus of cases. Detailed data are in Appendix L.*

Tape 1: Patient is a 19 year old male with multiple stab wounds to the chest and back: Attending, fellow, and a new 2nd year resident are working on the admission. This is the first day for the team as a whole and the fellow's second day working in the Trauma Resuscitation Unit. Patient has a history of asthma: The injury severity score for this patient is of 19 (relatively severe). This case is notable because the attending surgeon takes over control of the admission from the resident.

Time (m:s)	Key behavior	Description of behavior	Context
1:35	**strategic plan / taking control by attending**	Attending states priorities and strategic plan	Team is asking patient's name and assessing pupils for neurological status. Meanwhile there are bleeding stab wounds in his back…the attending points out that the stab wounds are in his back. [**Plan formed** by resident and attending is **Critiquing plans**]
1:58	**strategic plan / taking control by attending**	Attending takes over team	Team is asking about allergies and does not seem to be well coordinated. It is obvious that the patient is laying in a pool of blood. Attending appears agitated at the pace of the admission [**Error made** and attending **critiques plans** by taking over control. Time is critical so there is no **Coaching**]
2:33	**strategic plan**	Attending giving plan "put that there," etc referring to wiping blood off of back and assessing wounds	During log-roll, to further assess the wound location and depth, nurse removes the bloody sheet from under the patient.
2:40	**strategic plan**	Attending communicating plan, "we're going to roll him…"	Attending directs team to carry out log-roll because he wants to fully assess all of the patient's stab wounds and control the bleeding. [**Plan change** leads to announcement for **maintaining awareness**]
2:42	explicit request for info	Attending inquires about wound: "how deep is that?"	As a result of the log roll, new diagnostic information is available. [**New information available** leads to **Information request**]
5:19	**strategic planning**	Fellow talks about pt assessment with resident "we have 2 stab wounds we are worried about…"	Together they prioritize and develop a general strategy. Patient has weak pulses in upper and lower extremities, IV access established, O2 applied, head of bed at 60 degree angle to facilitate ventilation…they decide on specific x-rays. [**Novel situation** involving this difficult case precipitates **strategic planning, coaching** of fellow in forming a plan.]

Table 11.2: *Team leadership functions (horizontal) and the situations under which they occurred (vertical). An "x" denotes that a given function often occurs in a given situation. While all leadership functions may occur in all situations or conditions, the "x" markings denote the combinations most commonly observed in the corpus of cases.*

	Strategic planning	Reporting plans	Critiquing plans	Coaching	Maintaining awareness	Information requests
Protocol normal		x			x	
Task completed		x			x	x
New information available	x	x				x
Plan formed	x	x	x			
Change in status	x				x	
Plan changed	x	x			x	
Error made--time not critical			x	x		x
Error made--time critical			x			x
Resources inadequate	x			x		x
Novel situation	x			x	x	x
Membership change					x	x
Leadership change		x				x

Chapter 12. Summary

The research area of distant leadership under stress is becoming critical to current and future organizations, especially those in the military context. The project reported here should provide insight into the area in several directions.

Together the five studies we have conducted shed new light on team leadership in a complex, dynamic, high stakes and high stress setting. In this remarkable setting – the Trauma Resuscitation Unit – we have used multiple studies and multiple methods to illuminate the processes and functions of conventional, co-located leadership and to assess the effects of distance leadership. In this summary, we highlight some of the important findings that emerged from our research.

Key Findings

The Leadership System

In the trauma resuscitation unit that we studied, leadership does not reside in a single person, nor even in a single role. Rather, leadership is shared in a rigidly hierarchical yet flexible system of leader roles. The leader with the greatest expert and legitimate power is the attending surgeon. The attending surgeon is thus at the top of the hierarchy. The surgical fellow is just beneath the attending surgeon in the hierarchy, having less expertise and less legitimate authority than the attending surgeon. Lower still is the primary physician or resident in charge of the patient.

The guiding leadership principle within the TRU is that the lowest person in the leadership hierarchy should assume the primary role in leading the team (of surgeons, anesthesiologists, nurses, technicians, etc.) in treating the patient, provided that this individual has sufficient expertise to do so. If this individual lacks the expertise to ensure optimal care of the patient, leadership is transferred to the person one level above in the leadership hierarchy.

This leadership system assures that lower level leaders gain experience in treating shock trauma patients and in leading the team, provided they can do this work without compromising patient care. Further, the system allows more senior leaders to monitor patient care and to teach and coach more junior leaders and members of the team. In this way, the leadership system adjusts to task characteristics and team member characteristics, as described in more detail below, ensuring high quality patient care and team member learning and development.

The leadership system that we observed and documented in the TRU provides a striking counterpoint to existing leadership models which typically focus on organizational (not leader) and which assume that one individual plays the leadership role in an on-going fashion over time.

Leadership Functions

Dominant models of leadership behaviors and styles are not entirely applicable to the setting we studied. We found, for example, little to no evidence of charismatic, visionary, or transformational leadership in the TRU. Perhaps such leadership is unnecessary given that leaders confront life-or-death conditions on a daily basis. Their tasks – providing urgent care for at risk patients – may well be all the inspiration that team members need.

Instead, our studies suggest, collectively, that leaders within the TRU fulfill seven primary functions. First, they *provide strategic leadership*, clarifying team goals, plans, and priorities. Second, they *monitor the performance of the team*, carefully observing team members' care of the patient to prevent possible errors and to ameliorate any errors that do occur. Third, they *teach and coach* team members, to enhance and refine their knowledge and skills. Fourth, they *gather and disseminate information*, ensuring that team decisions are based on all relevant information and that such information is shared among team members as appropriate. Fifth, they *praise and critique other team members*, rewarding and correcting team members' actions during patient care. Sixth, they *serve as role models of calm and composed behavior and decision-making*, helping to ensure that team members stay focused on the task and do not devolve into disorganization or dissension. Finally, they *participate in a hands-on fashion in task performance (patient care)* when their expert and efficient task performance is required by the team.

Leadership Adaptation: Urgency and Expertise

Throughout our research, we observed that the TRU leadership system adapts to adjust to the urgency of the team's tasks and the expertise of the lowest team leaders. Thus, higher ranking members of the team hierarchy (the surgical fellow and the attending surgeon) are most likely to play an active role in patient care only when the patient requires urgent care and lower ranking individuals lack the expertise and experience to provide and ensure such care. When patient care is less urgent and/or lower ranking team leaders are quite expert and experienced, higher ranking members of the hierarchical leadership system play a less active role in patient care. Under these circumstances, they are likely only to monitor team performance – rather than performing any of the other six leadership functions outlined above.

Leadership at a Distance: Accommodation, Performance, and Stress

Our findings suggest that distant leadership – in which the most senior member of the leadership hierarchy operates at a distance from the rest of the team, communicating only through audio and visual technologies – is not harmful to task performance in the TRU. Our findings suggest that the leadership system is both flexible and redundant enough to accommodate the senior leader's distance from the team. That is, when the most senior leader is distant from the team, lower ranking members of the leadership hierarchy increase their performance of leadership functions (e.g., hands-on leadership, monitoring) that the most senior leader has difficulty performing from a distance.

Objective team performance measures based on speed and accuracy indicators were collected (described in Chapter 8). Distant leadership resulted in fewer task omissions while at

reduced speeds of accomplishing the tasks. We would suggest that under distant leadership, more team members enacted leadership and thus accuracy indicators would improve. However, limitations in communication may produce barriers to situation awareness of teams and hamper the speed of action. Due to the relative small number of sessions investigated and heterogeneity of the patients treated, we did not measure traditional patient outcome data, such as mortality rates.

This finding suggests that distant leadership may be functional for – or at least not inimical to – task performance in other settings as well. However, we would caution that the leadership system we have documented is both highly redundant and highly flexible. In the absence of such a leadership system, we suspect that distant leadership might well have negative effects of team task performance of all but the most routine tasks. Further, it is important to note that our tests had low statistical power to detect effects (given our small sample size). Finally, leaders were separated from team members for a short time period only (typically less than 30 minutes). These caveats call into some question the generalizability of our findings – a point to which we return below.

Although distant leadership did not influence team performance, it seemed to increase the stress level of the distant leaders and their key subordinates. Additional research is needed to determine whether stress remains high as senior leaders and their immediate subordinates (and other team members) gain more experience with distant leadership.

Directions for Future Research and Theory

Refining the Conceptual Model

Our exploration of team leadership under stress suggests that a hierarchical leadership system, guided by the principle of delegation of leadership authority to the lowest ranking leader(s) who possess requisite expertise for the task at hand, provides exceptional flexibility, ensuring high quality task performance and leader development and training. In future research and theory development, this basic conceptual model merits further exploration, definition, and refinement. The very notion of a "leadership system" challenges prevailing leadership theory. In subsequent research and theory development, the model should be expanded, specifying propositions to be tested in subsequent research. Further, the boundary conditions of the model require investigation: Under what circumstances is a hierarchical leadership system a viable, even optimal, form of leadership? Finally, the relationship of leadership tasks to the leadership hierarchy warrants consideration: Are certain functions typically performed by different leaders within the hierarchy? If so, why?

Leadership at a Distance

We have provided an important, but preliminary test of the effects of leadership at a distance. Our test lacked robust statistical power and the generalizability of our findings is uncertain. Accordingly, future research is needed to assess the effects of distant leadership in a larger sample and in other team settings.

Further, the existing literature provides little guidance regarding the circumstances in which distance leadership is most likely to be effective. Further theory development, providing hypotheses regarding the factors that maximize the benefits and minimize the detriments of distant leadership is much needed.

Finally, our findings suggest that distant leaders find distant leadership stressful. Here too additional research is needed to assess the generalizability of these findings and the stability of these findings over time (perhaps distance leadership becomes less stressful for leaders and subordinates as gain experience with distance leadership),

Implications to the Army

The study setting had numerous parallels to those encountered by the Army. Rapid assembly of team members, highly trained and motivated team members, and uncertain incoming workload, life and death decisions are some of the parallels. What would one draw from the findings of the studies reported here for leadership development in the Army? In addition to the research implications developed below, we would suggested several potentially fruitful areas to improve leadership effectiveness. First, team structures in dynamic task settings are fluid. To match the changes in team structure, distant leaders should be provided with maximum control of communication topologies. Secondly, leadership development, as built-in in the teams studied here, should be viewed as a necessary adaptation strategy for those teams that face highly fluctuating task demands. In the case of trauma resuscitation teams, they may have to be split up to treat more than one patient, and necessarily junior members have to enact leadership. In distant leadership conditions, some of the functions need to be fulfilled by people other than the leader. Worded differently, when a team is likely to encounter highly dynamic tasks, the team members should expect to provide leadership even they may not be designated as the leader. Thirdly, leadership should be assessed not only for the team performance achievement, but also for allowing leadership development among team members.

Beyond Immediate Task Performance

Throughout our research, we focused on the leadership of teams during specific, focused task performance – the initial treatment of trauma victims upon their arrival in the trauma resuscitation unit. However, the members of trauma teams (nurses, surgeons, anesthesiologists, technicians, etc.) typically spend only a relatively small portion of their work hours focused on the initial treatment of trauma victims. They also provide more routine, follow-up patient care once patients are stabilized. Further, they experience "down time" for record-keeping, rest, and socializing when patients are not present in the trauma resuscitation unit. Our research findings shed no light on leadership, stress, and performance during the performance of these less urgent tasks.

An analogy may clarify the point. Had we studied orchestras – not trauma teams – our research would have focused solely on each orchestra's live performances before an audience, the orchestra's most intense and important work. And yet, orchestra members spend long hours, individually and collectively, preparing, planning, and practicing. Thus, a focus solely on live performances would be incomplete – just as a focus solely on the initial treatment of trauma victims is incomplete. The teams and leadership system we studied perform numerous tasks that are far more routine and less urgent than the tasks that we have examined in our research.

Expanding the research focus to consider team performance and leadership beyond the initial treatment of trauma victims would enrich our understanding of team leadership in this setting.

Leadership and Development Over Time

Hundreds of surgical fellows and residents cycle through the Trauma Resuscitation Unit each year. Each of these individuals typically works for just one to two months in the TRU. Our research has not examined the development of these leaders over time. Rather, our focus has been static and limited. Future research should examine the acclimation, socialization, and development of surgical fellows and residents over time, to gain an appreciation of leader development over time in this highly dynamic setting. How do these individuals change and develop as they work in the TRU? What individual characteristics predict their development? How does the performance of more senior leaders in the leadership hierarchy influence the development of these more junior leaders?

Glossary

ABCs / ABCDE: Assessment strategy mnemonic for ATLS protocol, indicating assessment of **A**irway, **B**reathing and ventilation, and blood **C**irculation, **D**etermination of major injuries, and **E**xposure of the patient.

Amylase: An enzyme found in saliva. Sampling saliva provided the ability to measure amylase levels, which correlate to stress levels, thus providing a measure of stress.

ATLS: Advanced Trauma Life Support. A protocol for treatment of trauma patents.

Attending: A staff MD who has completed all training, which may have included residencies and fellowships. Attending physicians supervise residents and fellows.

CPA: Critical Procedural Analysis: a survey (rating form) completed by subject matter experts such as nurses, surgeons, and anesthesiologists who watched a videotaped admission and then rated patient characteristics, team performance, and so on.

CPR: Cardiopulmonary resuscitation.

CSCW: Computer supported collaborative work

CT: Computer Tomography

ER: Emergency Room

FAST: Focused Assessment with Sonography for Trauma (FAST) is a limited ultrasound examination for identifying the presence of free intraperitoneal or pericardial fluid.

Fellow: An MD who has completed a residency, and is continuing specialized training in a fellowship.

GCS: Glasgow coma scale, used for quantifying the degree of coma in a patient. .

ICC(1): Interclass correlation-1, tests how much of the variability in individual responses can be predicted by the case to which the data is being aggregated

ICC(2): Interclass correlation-2, tests the reliability of the grouping variable means.

IR: Infra-red

ISDN: Integrated Services Digital Network, a system of digital phone connections

ISS: Injury severity score, a standard measure used by hospitals to assess the severity of a patient's injury upon arrival. The score is correlated to the expected mortality of patients. High ISS score is associated with higher mortality.

MAACL: Multiple Affect Adjective Check List - Revised (MAACL-R): provides multi-dimensional assessment of participants' emotional state, to be used to attribute a specific cause to stress.

MLQ: Multifactor Leadership Questionnaire authored by Avolio, Bass, & Jung, 1995.

MPS: Managerial Practices Survey authored by Yukl, 1991.

OR: Operating Room

PQ(-): Pre-admission questionnaire a set of 4 questions regarding an individual's knowledge of and confidence about the upcoming admission.

PRQ: Post-Resuscitation Questionnaire: following the videotaping, a two-page questionnaire dealing with the team's performance during the admission was administered to the Attending, Fellow and Resident participating in the admission.

PVR: Post-resuscitation Video Review: an assessment of performance of the team during the case was carried out by the participants, either through a written questionnaire or through audio-taped narrative commentary.

Resident: An MD who is completing a residency program, which is training required after medical school.

$r_{wg(j)}$ A correlation coefficient that assesses the agreement or degree to which raters provide essentially the same rating in order to determine if individual ratings are interchangeable.

SME: Subject Matter Expert

TRU: Trauma resuscitation unit

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List of Appendices

Appendix A.

IRB Approval Form

DSSURYDERYHSDJHRU [[RH-U

UNIVERSITY OF MARYLAND
BALTIMORE
INSTITUTIONAL REVIEW BOARD

TO: YAN XIAO PhD
Anesthesiology
ROOM 534 MSTF

FROM: INSTITUTIONAL REVIEW BOARD

DATE: November 17, 2000

RE: **IRB PROTOCOL #0700226**

"Ethical Leadership"

Expires 11/17/2003 Report required twice yearly

Response to correspondence dated 10/09/2000

This is to certify that the Institutional Review Board has reviewed your response to their queries and fully approved your protocol. **Please note that the enclosed stamped consent form expires on the anniversary date of this protocol. The expiration date can be found on the last page of the consent form.**

You must notify the IRB if the project is altered in any way (change in location, personnel, number of subjects, age of subjects, or any change in research protocol). If you have any questions, please do not hesitate to contact the Office for Research Subjects by e-mail (ORS@umaryland.edu) or by phone (at 706-5037).

William A. Blattner, M.D.
Chairman, IRB

Date: Thursday, August 30, 2001
To: YAN XIAO, PhD
Re: IRB protocol **#0700226**

The UMB IRB met on 8/16/2001 and approved the annual report and renewal request for your project entitled, "Distant Leadership." This approval is effective for 365 days and expires on 11/17/2001. If you wish to continue the project beyond this period, please submit a renewal request 30 days before the project is due to expire.

Investigators are reminded that all UMB IRB approved consent forms display an expiration date on the last page. Please make a practice of checking this date carefully each time any UMB IRB consent form is used, as using expired forms to consent subjects is considered a significant deviation from Federal Regulations governing research involving human subjects.

Investigators are also reminded that the IRB must be notified if the project is altered in any way (change in location, personnel, number of subjects, age of subjects, or any change in research protocol). If you have any questions, please do not hesitate to contact the Office for Research Subjects by email (ORS@som.umaryland.edu) or by phone (at 706-5037).

Leslie J. Katzel, M.D., PhD.
Chair, UMB IRB

Appendix B.

IRB Consent Form

RESEARCH CONSENT FORM

The University of Maryland, Baltimore

Title of Research Project Distant Leadership Under Stress

Principal Investigator: **Yan Xiao, PhD** **Phone: 410-706-3418**

PURPOSE OF STUDY

This study will examine team leadership during trauma resuscitation when all members are co-located and when a leader is distant to the team but is provided with varying telecommunication links. Through prospective experimentation, this study will test whether there is an impact on team leadership, team coordination and decision-making of having the leaders co-located or at a distance, and whether leadership is affected by whether the communication has audio-video or just audio alone. Performance-based measures of the teleconsultant's leadership of resuscitation will be tested by examining both the on-site and the remote teleconsultant's decision-making (i.e. diagnosis and intervention recommendations), risk assessment (whether a procedure should be carried out) and contingency planning (If Plan A does not work what is Plan B and C).

Research subject. You are asked to join the study because you are a member of Trauma Resuscitation Unit (TRU) trauma teams, which include surgical crew (the attending surgeon, the fellow, surgical and emergency medicine residents, and medical students), anesthesia crew (the attending anesthesiologist, residents, and nurse anesthetists), and trauma nurses. You may be considered as a leader under study for a particular patient admission if you are the attending surgeon, the fellow, or the surgical chief resident.

PROCEDURES

The manipulation of location of leaders and data collection will be carried out for trauma patient initial assessment and resuscitation in chosen experiment shifts between 8:00am and 6:00pm according to logistical factors until the desired number of experiment shifts has been reached. During an experiment shift, each patient admission constitutes a session. A session starts when TRU is first notified of a pending admission of a trauma patient, and ends when first and secondary surveys are accomplished by the trauma team, usually within 10-30 minutes of an admission.

A second attending observer will be in the TRU during experiment sessions to ensure patient safety and maintain standard of care. Whenever possible, this observer will be a surgeon. If it is anticipated that a surgeon is not available as the observer for the experiment, an attending anesthesiologist will be asked to function as an observer. If an attending observer is not available, the experiment session will be cancelled. The second attending observer will be ask to intervene should the patient safety or standard of care not be secured.

Three leadership conditions will be randomly assigned to each shift (all admissions during each shift will be under the same leadership condition): low-bandwidth, high-bandwidth, and co-locational.

- Low-bandwidth: the leader is distant to the rest of the trauma team, with two-way wireless (infrared based) audio connection to all team members, plus a slave display of patient vital sign monitor
- High-bandwidth: the leader is distant to the rest of the trauma team; in addition to audio and the vital sign display, the leader has two visual views of the trauma patient resuscitation through two video cameras aiming around the patient
- Co-locational: the control condition, in which the leader is in the bay of the trauma resuscitation unit (TRU) with the rest of the team members.

If you are a leader under study, for the two distant leader conditions, you will be in the telecontrol room, steps away from the TRU bays. The room is equipped with audio, video and data terminals connected to the bays. If you are a member of the trauma team, you will be given a telecommunication headset, through which you can talk with the leader when the leadership condition is not co-locational.

Randomization. Before the start of an experiment shift, the leadership condition will be determined by looking up an a prior constructed randomization table. Should an experiment shift be aborted before it ends, the same leadership condition will be adopted for the next experiment shift.

Number of experiment shifts to be studied. We plan to conduct a total of 24 experiment shifts with eight (8) in each of the three leadership conditions.

Data collection. You will be asked to fill out a one-time survey on leadership. This one-time survey will take up to 30 minutes to finish. For each session during experiment shifts, data will be collected by the use of data-audio-video recordings:

- Just before the patient arrival, you may be prompted to answer questions in short and brief manners on your planning activities. Answering these questions will take 1~3 minutes.
- When the most intensive activities are over during the session, you may be prompted to answer questions in short and brief manners on the events just occurred. Answering these questions will take 1~3 minutes.
- At the end of a session, you will be asked to fill in a short questionnaire which should take you less than five minutes.
-

Your opinion of whether you can participate in data collection procedures will always be respected.

If time allows in your judgment, you will be asked to review the recordings of a session and your reviews will be audiotaped for later analysis. This review may take as long as one hour but can be as short as 10 minutes.

Auxiliary data to be collected. With additional verbal consent from you, a drop of saliva will be taken at (1) baseline (non-stress) condition, and (2) the start and the end of an experiment session.

What is innovative. Studying distant leadership in real, stressful environment is innovative. Using telecommunication headsets for trauma teleconsulting is innovative. Videotaping of trauma patient resuscitation and video-analyzing performance is innovative. Through videotaping, performance can be evaluated by measures include analysis of communications, assessment of risk, appropriateness of recommendations for intervention and comparison with standards of care such

as Advanced Trauma Life Support and American Society of Anesthesiologists practices guidelines.

What will be done for research? All patients will require resuscitation: no patient care will be affected by this study. The research part of the study includes the analysis of the ways the distributed team use the audio-video data links during resuscitation. The debriefing while reviewing the recording of the resuscitation will also be audio-taped and will be part of the research.

RISKS/DISCOMFORTS

Recordings of your performance will be reviewed by one or two of your peers immediately after recording is made. During the review your performance may be critiqued. Further video analysis will be performed by different analysts: the PI and the co-investigators. The videotapes will not be reviewed and analyzed by medical director (Physician-in-chief). The audio or video recordings and their reviews will not be used in any job actions. Your employment status will not be affected by the audio/video recordings and their reviews. There are no socioeconomic or physical risks associated with your participation in this study.

Our experience has shown that prolonged use of the telecommunication headset may be uncomfortable to some people. Should you find the headset interfering with your work, you should remove it at that time.

There are no known risks in taking small samples of saliva in the auxiliary data collection procedure. The saliva sample will only be used in amylase assay for the purpose of measuring stress response.

BENEFITS

You will not benefit from participate in this study. However, the teleconsulting by distant leaders and use of video debriefing may prove useful to you in managing patients during resuscitation in the future.

ALTERNATIVES

Your only alternative is to not participate in this study.

COSTS/COMPENSATION

There is no added costs nor compensation to you for your participation.

CONFIDENTIALITY

In all written data collection procedures, all information identifying names (patients and care providers) will be removed. For filled questionnaires, the data will be extracted to remove information identifying respondents and the original paper forms destroyed.

During video analysis, all audio-video recordings will be stored in a special video analysis room in the Medical School Teaching Facilities (MSTF) adjacent to the PI's office. The video analysis room

has lock and dedicated access key. Video analysis will be performed by members of the research team (the PI and the co-investigators) and by you if you are a care provider in the recorded case.

At its choice, IRB may review audio-video recordings in carrying out its missions.

With the exception of samples, all audio-video recordings will be destroyed with a degausser at the end of video analysis, which should take no longer than three (3) months after the date of recording. You will be ask to give a separate consent should audio-video samples be used for illustration and research purposes.

We will play the videotape on which you are recorded should you request. We will block your face on the videotape or destroy the videotape should you request it.

RIGHT TO WITHDRAW

Participation in this study is voluntary. Your employment status will not be affected by your decision to participate or not participate in the study.

You have the right to refuse to be videotaped or audio-taped as part of this study. If you wish, we will destroy any recordings or videotape, immediately after completion of resuscitation if there is any performance that you do not wish to have included in the study for any reason. If you find that the audio or video equipment interferes with your normal clinical practice, then you should remove it and practice in the usual manner. In all circumstances, the usual Attending Level support will be available; they may be standing next to you to help. The distant leader, not the person next to you, will be providing information and asking questions. If you do not wish to participate on a particular resuscitation, you can choose not to do so without influencing the outcome of the study or your participation in future resuscitations.

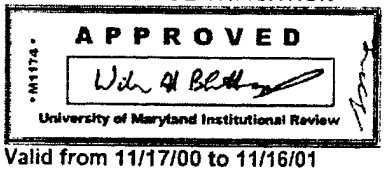
UNIVERSITY STATEMENT

The University is committed to providing subjects of its research all rights due them under State and federal law. You give up none of your legal rights by signing this consent form or by participating in the research project. Please call the Institutional Review Board (IRB) if you have questions about your rights as a research subject.

The research described in this consent form has been classified as minimal risk by the University of Maryland Institutional Review Board (IRB), a group of scientists, physicians, and other experts. The Board's membership includes persons who are not affiliated with the University and persons who do not conduct research projects. The Board's decision that the research is minimal risk does not mean that the research is risk-free, however, Generally speaking, you are assuming the risks of research participation, as discussed in the consent form. But, if you are harmed as a result of the negligence of a research, you can make a claim for compensation. If you believe you have been harmed through participation in this research study as a result of resea4rcher negligence, you can contact the IRB for more information about claims procedures.

Institutional Review Board
University of Maryland
655 West Baltimore Street, #BRB-14-016
Baltimore, Maryland 21201
(410-706-5037

If you agree to join this study, please sign your name below.
NOT VALID WITHOUT THE IRB STAMP OF CERTIFICATION



Valid from 11/17/00 to 11/16/01

_____
Subject's signature

Date:_____

___ I have read and understand the information on this form

___ I have had the information on this form explained to me.

_____ Date:_____
Signature of Parent/Guardian
(When Applicable)

_____ Date:_____
Signature of Investigator or authorized Representative obtaining informed consent

_____ Date:_____
Witness to Consent procedures
(Optional unless subject is illiterate, or unable to sign)

NOTE: Copies of this Consent Form with original signatures **must** be a) retained on file by the Principal Investigator; and b) given to the subject. A copy must also be deposited in the patient's medical record (if any).

Appendix C.

Critical Procedures Analysis (CPA) forms

CRITICAL PROCEDURAL ANALYSIS
(V.3, 6/6/01)

Case ID: _____ Reviewer ID (last four digits of SSN):_____

This part of data analysis is to solicit your opinions as a subject matter expert about a videotaped resuscitation in TRU. During and after reviewing videotapes, you will be asked to

1. identify ATLS-related tasks performed
2. characterize the admission
3. provide your assessment of performance
4. identify critical incidents

Note:

1. The opinions you provide will be aggregated with those from other subject matter experts and will not be associated with your names in the analyzed results.
2. The videotapes that you're about to review contain **privileged** information collected solely for research. You are requested to keep the information **confidential**. If you feel that you cannot do so, please inform the assistant data analyst immediately.
3. Your comments and ratings are extremely important to the understanding of events and activities during resuscitation. You may stop and rewind videotapes at any time.
4. The phrase "care providers" refers to everyone in a particular resuscitation, including the nurses, anesthesia care providers, surgical members, and trauma technician.

SPECIAL NOTES FOR SECTION IV ON LEADER BEHAVIOR
DEFINITION AND EXAMPLES

You will be rating the extent to which three individuals (the attending surgeon, the surgical fellow, and the resident) engaged in specific behaviors during the admission. Please remember that none of these individuals may engage in those behaviors during an admission, or one may, or two may, or all three of them may.

In rating the extent to which the three individuals engaged in specific behaviors during the admission, please remember that there is no single "best way" for each of these individuals to perform. If a given individual never shows one of the behaviors, that does not mean that the individual is good or bad.

1. Provide strategic direction to the care providers

Definition

- Explicitly tells the care providers the overall plan or strategy for treating the patient.
- Allocates specific tasks to different care providers.
- Requests or directs someone to perform a specific task.

Examples

- "Here's what we're going to do…"
- "Do 'A' first, and then do 'B'"
- "You're going to do a C-spine, aren't you?"
- "Pat, I want you to do 'A' and, Dana, I want you to do 'B'."

2. Participate in patient care in a hands-on fashion

Definition

- Physically touches the patient.
- Talks directly to the patient.
- Personally performs procedures or tasks to treat the patient (e.g., sticks the patient, manipulates the probe for the FAST, etc.).
- Assists in patient treatment by supporting others' work (e.g. passing supplies, setting up devices).

3. Teach other care providers to perform specific tasks

Definition

- Instructs or shows one or more care providers how to perform a specific task..
- Talks one or more care providers through each step of a multi-step procedure.
- Explains to one or more care providers the reason for performing (or not performing) a specific task.

Examples

- "Okay, let me show you how to do this."
- "To find the spleen, move your hand up a little"
- "You want to be careful not to do 'A,' because…"

4. Praise other care providers

Definition

- Tells a care provider he or she did something well.
- Indicates that he or she is pleased with another care provider's actions.
- Shows his or her approval of another care provider's actions.

Examples

- "Good work"
- "Outstanding!"
- "Okay. I think that's fine"

5. Monitor the care providers

Definition

- Watches what other care providers are doing to be certain the care providers does not make an error in treating the patient.
- Observes the care providers, paying close attention to the care providers' progress and the appropriateness of patient treatment
- Asks care providers for information about the admission to be sure that the care provider's treatment of the patient care is appropriate.

6. Remain calm and composed

Definition

- Appears relaxed, unexcited, and confident throughout the admission.
- Shows no impatience or irritation with other care providers.
- Shows no anger or frustration with other care providers.Speaks to other care providers in a measured, unexcited tone of voice.

Section I: ATLS protocol. Enter the time as displayed when the following steps were performed. If a step was not applicable or not appropriate, please indicate so.

		Timecode HH:MM:SS	N/A	Comment
Airway	1. Immobilize neck	__:__:__	❑	
	2. Apply oxygen	__:__:__	❑	
	3. Check mouth/oropharynx	__:__:__	❑	
	4. Maintain airway (Guedel, etc.)	__:__:__	❑	
Breathing	5. Inspect chest	__:__:__	❑	
	6. Palpate chest	__:__:__	❑	
	7. Auscultate chest	__:__:__	❑	
Circulation	8. Expose entire patient	__:__:__	❑	
	9. Blood pressure	__:__:__	❑	
	10. Check manually if abnormal	__:__:__	❑	
	11. Pulse oximetry	__:__:__	❑	
	12. IVs placed w/ appropriate size & # of lines	__:__:__	❑	
	13. IV fluids ordered	__:__:__	❑	
Secondary	14. Head	__:__:__	❑	
Survey	15. Ears	__:__:__	❑	
	16. Eyes	__:__:__	❑	
	17. Face	__:__:__	❑	
	18. Chest	__:__:__	❑	
	19. Abdomen	__:__:__	❑	
	20. Extremities	__:__:__	❑	
	21. Log-roll	__:__:__	❑	
	22. Inspection and palpation spine	__:__:__	❑	
	23. Rectal exam	__:__:__	❑	
	24.Check bloods sent	__:__:__	❑	
	25. Ultrasound exam (FAST)	__:__:__	❑	
	26. Chest X-ray	__:__:__	❑	
	27. Direction to radiographer	__:__:__	❑	
	28. Overall plan announced to all	__:__:__	❑	

Section II: Characterization of the admission. Provide your opinions on this admission against all other admissions in TRU.

1	2	3	4	5
Strongly Disagree	***Disagree***	***Don't Agree or Disagree***	***Agree***	***Strongly Agree***

	Disagree ←				→Agree
1. This patient admission required immediate resuscitative action upon arrival.	**1**	**2**	**3**	**4**	**5**
2. In the TRU, we often see injuries of this sort.	**1**	**2**	**3**	**4**	**5**
3. Soon after patient's arrival, the care providers knew precisely patient status and condition.	**1**	**2**	**3**	**4**	**5**
4. Differential diagnoses became clear to the care providers immediately.	**1**	**2**	**3**	**4**	**5**
5. The patient was highly unstable.	**1**	**2**	**3**	**4**	**5**
6. The resuscitative procedures were risky.	**1**	**2**	**3**	**4**	**5**
7. This admission was very stressful to the care providers.	**1**	**2**	**3**	**4**	**5**

Section III: Performance Indicators. Think about the average performance of TRU care providers in treating patients like this one. Provide your assessment of the performance during this admission.

	Disagree ←				→Agree
1. The care providers were well prepared for the admission.	1	2	3	4	5
2. The care providers accomplished primary survey (ABC) in timely manner.	1	2	3	4	5
3. The care providers arrived at definitive diagnosis plan in timely manner.	1	2	3	4	5
4. The care providers prioritized tasks well.	1	2	3	4	5
5. There was excessive risk-taking in this admission.	1	2	3	4	5
6. The technical approach was ideal.	1	2	3	4	5
7. The definitive diagnosis plan was optimal.	1	2	3	4	5
8. The care providers exploited teaching opportunities appropriately.	1	2	3	4	5
9. All in all, the care providers performed extremely well in treating the patient's injuries.	1	2	3	4	5

10. Compared to other admissions, how well did these care providers perform in treating this patient? (Please circle the number)

Greatly Below Average	*Below Average*	*Average*	*Above Average*	*Greatly Above Average*

Comments on the performance during resuscitation

Section IV. Leader Behaviors. Based on what you observed on the videotape, to what extent did the attending surgeon, the surgical fellow or chief resident, and the admitting resident each perform the following six behaviors? Please circle the number that best corresponds to your opinion using the scale below.

1	2	3	4	5
To Little or No Extent	*To a Limited Extent*	*To Some Extent*	*To a Considerable Extent*	*To a Great Extent*

	Attending Surgeon					Fellow/Chief Resident					Admitting Resident				
1. Provide strategic direction to the care providers	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
2. Participate in patient care in a hands-on fashion	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
3. Teach other care providers to perform specific tasks	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
4. Praise other care providers	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
5. Monitor the care providers	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
6. Remain calm and composed	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5

Section V. Resuscitation process. Provide your assessment of how this admission was conducted.

1	2	3	4	5
Strongly Disagree	*Disagree*	*Don't Agree or Disagree*	*Agree*	*Strongly Agree*

	Disagree ←				→Agree
1. Care providers coordinated their tasks in a smooth and orderly fashion.	1	2	3	4	5
2. While treating the patient, care providers got in each other's way.	1	2	3	4	5
3. Care providers seemed to have a shared understanding of the treatment plan.	1	2	3	4	5
4. Care providers seemed to anticipate each other's actions without being told.	1	2	3	4	5
5. There was conflict among some care providers.	1	2	3	4	5
6. There was obvious friction between some members of the care providers.	1	2	3	4	5
7. The attending intervened more than usual during this admission.	1	2	3	4	5
Reasons for intervention: _____					
8. The care providers needed the attending's direction more than usual.	1	2	3	4	5
Reasons for direction: _____					
9. The care providers conducted treatment in a timely manner	1	2	3	4	5
10. The care providers communicated clearly	1	2	3	4	5

Section VI. Critical Incidents. Use the following two lists as reference. Were there any activities or situations that you would like to identify and comment about this admission?

Situations when

1. leadership is excellent or poor (needed but not provided)
2. teaching opportunity is not effectively exploited
3. coordination/communication is excellent or breaks down
4. excessive stress and workload occurs
5. patient status/injury is unusual

Occurrences of attending's and fellow's involvement as

1. Surveying/monitoring
2. Requesting information about patient and task status
3. Requesting and critiquing reported plans
4. Providing technical instruction
5. Providing strategic guidance
6. Providing performance feedback/critique
7. Providing teamwork guidance

Appendix D.

Pre- and Post-resuscitation questionnaires (PQ- and PRQ) forms for Attending Surgeon

PQ(-) Attending

Before the patient arrives, please answer the following 3 questions and provide a saliva sample.

1	2	3	4	5
Strongly Disagree	***Disagree***	***Don't Agree or Disagree***	***Agree***	***Strongly Agree***

Compared to other TRU trauma admissions before arrival…

1.	I am very well informed about the status of the patient	**1**	**2**	**3**	**4**	**5**
2.	The patient is anticipated to be stable	**1**	**2**	**3**	**4**	**5**
3.	<question eliminated>	**1**	**2**	**3**	**4**	**5**
4.	I know exactly what each team-member will be doing during the admission	**1**	**2**	**3**	**4**	**5**

Post Resuscitation Questionnaire (PRQ)

This questionnaire is part of a study examining leadership. There are no right or wrong answers. Your answers will be completely confidential and voluntary. "Crew" refers to everyone involved.

Last 4 digit of your SSN: _____

I. Patient's injuries. Please circle the number that best corresponds to your opinion using the scale below.

1	2	3	4	5
Strongly Disagree	*Disagree*	*Don't Agree or Disagree*	*Agree*	*Strongly Agree*

1.	This admission required immediate resuscitative action upon arrival.	1	2	3	4	5
2.	We did not have a moment to spare in treating the patient's injuries.	1	2	3	4	5
3.	I have previously treated patients with injuries of this nature.	1	2	3	4	5
4.	In the TRU, we often see injuries of this sort.	1	2	3	4	5
5.	Soon after patient's arrival I knew precisely the patient status and condition.	1	2	3	4	5
6.	Differential diagnoses became clear to me immediately.	1	2	3	4	5

II. Crew behavior. Please circle the number that best corresponds to your opinion using the scale below.

1	2	3	4	5
To Little or No Extent	*To a Limited Extent*	*To Some Extent*	*To a Considerable Extent*	*To a Great Extent*

*To what extent did **each** of the following three crew members:*
(1) myself, (2) fellow/chief resident, and (3) the admitting resident ...

		Myself					Fellow/Chief Resident					Admitting Resident				
1.	Tell others what strategy to use to treat the patient?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
2.	Communicate an overall plan for the crew to follow?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
3.	Actively participate in the resuscitation?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
4.	Provide hands-on treatment of the patient?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
5.	Teach others how to perform a task?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
6.	Explain to others precisely how to perform a task?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
7.	Oversee crewmembers' treatment of the patient?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
8.	Watch the crew in order to prevent errors?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
9.	Give credit when crewmembers did their job well?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
10.	Express satisfaction when crewmembers did well?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
11.	Remain calm throughout patient treatment?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
12.	Remain composed and unflappable?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5

III. Task characteristics. Mark on the following analog scales of how you felt **during** the admission.

1. Stress. How much stress did you experience during the admission?

Not Stressful 0 10 20 30 40 50 60 70 80 90 100 Extremely Stressful

2. Time Pressure. Did you feel time pressure during the admission?

Low Pressure 0 10 20 30 40 50 60 70 80 90 100 High Pressure

3. Mental Effort. How intensive was your mental effort during the admission?

Low Effort 0 10 20 30 40 50 60 70 80 90 100 High Effort

IV. Crew activities. Please circle the number that best corresponds to your opinion using the scale below.

1	2	3	4	5
Strongly Disagree	*Disagree*	*Don't Agree or Disagree*	*Agree*	*Strongly Agree*

1.	Crewmembers coordinated their tasks in a smooth and orderly fashion.	1	2	3	4	5
2.	While treating the patient, crewmembers got in each other's way.	1	2	3	4	5
3.	Every crewmember had a shared understanding of the treatment plan.	1	2	3	4	5
4.	Crewmembers could anticipate each other's actions without being told.	1	2	3	4	5
5.	There was conflict among some members of the crew.	1	2	3	4	5
6.	There was obvious friction between some members of the crew.	1	2	3	4	5
7.	The team members agreed on all decisions and goals during this admission.	1	2	3	4	5
8.	I knew what all the other members of the team were trying to accomplish.	1	2	3	4	5
9.	I felt the need to intervene more than usual during this admission.	1	2	3	4	5
10.	The crew needed my direction more than usual.	1	2	3	4	5
11.	I learned new skills during this admission.	1	2	3	4	5
12.	I gained new information, insights, or abilities during this admission.	1	2	3	4	5
13.	I look forward to working again with the same crew.	1	2	3	4	5
14.	The crew developed a good sense of teamwork.	1	2	3	4	5
15.	All in all, the crew performed extremely well in treating the patient's injuries.	1	2	3	4	5

16. Think about the <u>average</u> performance of TRU crews in treating patients like this one. <u>Compared to other TRU crews</u>, how well did this crew perform in treating this patient? (Please circle the number)

1	2	3	4	5
Greatly Below Average	*Below Average*	*Average*	*Above Average*	*Greatly Above Average*

V. Experience. Please mark the box that best corresponds to your experience (not including current admission).

1. How many patients have you treated (circle one):

...in the past 24 hours	0 patients	1-3 patients	4-6 patients	7-10 patients	11+ patients
...in your tenure at the TRU	0 patients	1-5 patients	6-10 patients	11-15 patients	20+ patients

2. In the past ***24 hrs***, how many patients have you treated *<u>with the following people</u>* (circle one):

this Admitting Resident	0 patients	1-3 patients	4-6 patients	7-10 patients	11+ patients
this Fellow/Chief Resident	0 patients	1-3 patients	4-6 patients	7-10 patients	11+ patients

3. In ***your tenure in the TRU,*** how many patients have you treated <u>with the *following people*</u> (circle one):

this Admitting Resident	0 patients	1-5 patients	6-10 patients	11-15 patients	20+ patients
this Fellow/Chief Resident	0 patients	1-5 patients	6-10 patients	11-15 patients	20+ patients

On the following page are 132 words that describe moods and feelings. Please select any words that describe the way you felt during the admission. Check all words that describe your feelings. (Work rapidly)

PVR – Attending

As you review the video of the case, please answer the following questions. "At this point" refers to the end of the study-portion of the admission

1	2	3	4	5
Strongly Disagree	*Disagree*	*Don't Agree or Disagree*	*Agree*	*Strongly Agree*

1. Provide about three differential diagnoses at this point A. _____ B. _____ C. _____	
2. At this point, I know precisely the patient status and condition	1 2 3 4 5
3. The patient is currently stable	1 2 3 4 5
4. At this point, I have a clear plan and disposition decided for this patient	1 2 3 4 5
5. Describe three goals of the team at this point A. _____ B. _____ C. _____	
6. I knew precisely what the team was trying to do	1 2 3 4 5
7. Describe any directions you might have had for the team but have not given yet. A. _____ B. _____ C. _____	
8. My ability to direct and communicate to the team was optimal	1 2 3 4 5

Appendix E.

Pre- and Post-resuscitation questionnaires (PQ- and PRQ) forms for Fellow Surgeon

PQ(-) Fellow

Before the patient arrives, please answer the following 3 questions and provide a saliva sample.

1	2	3	4	5
Strongly Disagree	***Disagree***	***Don't Agree or Disagree***	***Agree***	***Strongly Agree***

Compared to other TRU trauma admissions before arrival…

1.	I am very well informed about the status of the patient	**1**	**2**	**3**	**4**	**5**
2.	The patient is anticipated to be stable	**1**	**2**	**3**	**4**	**5**
3.	<question eliminated>	**1**	**2**	**3**	**4**	**5**
4.	I know exactly what each team-member will be doing during the admission	**1**	**2**	**3**	**4**	**5**

Distance Leadership Project FELLOW Date___/___/___ Case ID ____

Post Resuscitation Questionnaire (PRQ)

This questionnaire is part of a study examining leadership. There are no right or wrong answers. Your answers will be completely confidential and voluntary. "Crew" refers to everyone involved.

Last 4 digit of your SSN: _____

I. Patient's injuries. Please circle the number that best corresponds to your opinion using the scale below.

1	2	3	4	5
Strongly Disagree	*Disagree*	*Don't Agree or Disagree*	*Agree*	*Strongly Agree*

1. List briefly up to three differential diagnoses.

   a) _____

   b) _____

   c) _____

2. This admission required immediate resuscitative action upon arrival.	1	2	3	4	5
3. We did not have a moment to spare in treating the patient's injuries.	1	2	3	4	5
4. I have previously treated patients with injuries of this nature.	1	2	3	4	5
5. In the TRU, we often see injuries of this sort.	1	2	3	4	5
6. Soon after patient's arrival I knew precisely the patient status and condition.	1	2	3	4	5
7. Differential diagnoses became clear to me immediately.	1	2	3	4	5
8. I know precisely how closely the attending monitored the admission	1	2	3	4	5
9. I felt the admission was intensively monitored by the attending physician	1	2	3	4	5
10. The attending was an immediately available resource for this admission	1	2	3	4	5
11. The attending showed high trust in the crew's ability to handled the admission	1	2	3	4	5

II. Crew behavior. Please circle the number that best corresponds to your opinion using the scale below.

1	2	3	4	5
To Little or No Extent	*To a Limited Extent*	*To Some Extent*	*To a Considerable Extent*	*To a Great Extent*

*To what extent did **each** of the following three crew members:*
(1) Myself, (2), the Admitting Resident and (3) Attending Surgeon...

	Myself					Admitting Resident					The Attending Surgeon				
1. Tell others what strategy to use to treat the patient?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
2. Communicate an overall plan for the crew to follow?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
3. Actively participate in the resuscitation?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
4. Provide hands-on treatment of the patient?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
5. Teach others how to perform a task?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
6. Explain to others precisely how to perform a task?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
7. Oversee crewmembers' treatment of the patient?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
8. Watch the crew in order to prevent errors?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
9. Give credit when crewmembers did their job well?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
10. Express satisfaction when crewmembers did well?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
11. Remain calm throughout patient treatment?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
12. Remain composed and unflappable?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5

13. List briefly up to three goals of the team during the resuscitation

   a) _____

   b) _____

   c) _____

Distance Leadership Project FELLOW Date___/___/___ Case ID ____

III. Task characteristics. Mark on the following analog scales of how you felt **during** the admission.

1. Stress. How much stress did you experience during the admission?

Not Stressful 0 10 20 30 40 50 60 70 80 90 100 Extremely Stressful

2. Time Pressure. Did you feel time pressure during the admission?

Low Pressure 0 10 20 30 40 50 60 70 80 90 100 High Pressure

3. Mental Effort. How intensive was your mental effort during the admission?

Low Effort 0 10 20 30 40 50 60 70 80 90 100 High Effort

IV. Crew activities. Please circle the number that best corresponds to your opinion using the scale below.

1 *Strongly Disagree*	2 *Disagree*	3 *Don't Agree or Disagree*	4 *Agree*	5 *Strongly Agree*

1. Crewmembers coordinated their tasks in a smooth and orderly fashion.	1	2	3	4	5
2. While treating the patient, crewmembers got in each other's way.	1	2	3	4	5
3. Every crewmember had a shared understanding of the treatment plan.	1	2	3	4	5
4. Crewmembers could anticipate each other's actions without being told.	1	2	3	4	5
5. There was conflict among some members of the crew.	1	2	3	4	5
6. There was obvious friction between some members of the crew.	1	2	3	4	5
7. The team members agreed on all decisions and goals during this admission.	1	2	3	4	5
8. I knew what all the other members of the team were trying to accomplish.	1	2	3	4	5
9. I felt the need to intervene more than usual during this admission.	1	2	3	4	5
10. The crew needed my direction more than usual.	1	2	3	4	5
11. I learned new skills during this admission.	1	2	3	4	5
12. I gained new information, insights, or abilities during this admission.	1	2	3	4	5
13. I look forward to working again with the same crew.	1	2	3	4	5
14. The crew developed a good sense of teamwork.	1	2	3	4	5
15. All in all, the crew performed extremely well in treating the patient's injuries.	1	2	3	4	5

16. Think about the average performance of TRU crews in treating patients like this one. Compared to other TRU crews, how well did this crew perform in treating this patient? (Please circle the number)

1 *Greatly Below Average*	2 *Below Average*	3 *Average*	4 *Above Average*	5 *Greatly Above Average*

V. Experience. Please mark the box that best corresponds to your experience (not including current admission).

1. How many patients have you treated: (circle one):

...in the past 24 hours	0 patients	1-3 patients	4-6 patients	7-10 patients	11+ patients
...in your tenure at the TRU	0 patients	1-5 patients	6-10 patients	11-15 patients	20+ patients

2. In the past **24 hours**, how many patients have you treated *with the following people* (circle one):

this Attending Surgeon	0 patients	1-3 patients	4-6 patients	7-10 patients	11+ patients
this Admitting Resident	0 patients	1-3 patients	4-6 patients	7-10 patients	11+ patients

3. In ***your tenure in the TRU*** how many patients have you treated with the *following people* (circle one):

this Attending Surgeon	0 patients	1-5 patients	6-10 patients	11-15 patients	20+ patients
this Admitting Resident	0 patients	1-5 patients	6-10 patients	11-15 patients	20+ patients

On the following page are 132 words that describe moods and feelings. Please select any words that describe the way you felt during the admission. Check all words that describe your feelings. (Work rapidly)

Appendix F.

Pre- and Post-resuscitation questionnaires (PQ- and PRQ) forms for Surgical Resident

PQ(-) Primary Physician

Before the patient arrives, please answer the following 3 questions and provide a saliva sample.

1	2	3	4	5
Strongly Disagree	*Disagree*	*Don't Agree or Disagree*	*Agree*	*Strongly Agree*

Compared to other TRU trauma admissions before arrival…

1.	I am very well informed about the status of the patient	1	2	3	4	5
2.	The patient is anticipated to be stable	1	2	3	4	5
3.	<question eliminated>	1	2	3	4	5
4.	I know exactly what each team-member will be doing during the admission	1	2	3	4	5

Post Resuscitation Questionnaire (PRQ)

This questionnaire is part of a study examining leadership. There are no right or wrong answers. Your answers will be completely confidential and voluntary. "Crew" refers to everyone involved.

Last 4 digit of your SSN: _____

I. Patient's injuries. Please circle the number that best corresponds to your opinion using the scale below.

1	2	3	4	5
Strongly Disagree	*Disagree*	*Don't Agree or Disagree*	*Agree*	*Strongly Agree*

1. List briefly up to three differential diagnoses.

   a) _____

   b) _____

   c) _____

2.	This admission required immediate resuscitative action upon arrival.	1	2	3	4	5
3.	We did not have a moment to spare in treating the patient's injuries.	1	2	3	4	5
4.	I have previously treated patients with injuries of this nature.	1	2	3	4	5
5.	In the TRU, we often see injuries of this sort.	1	2	3	4	5
6.	Soon after patient's arrival I knew precisely the patient status and condition.	1	2	3	4	5
7.	Differential diagnoses became clear to me immediately.	1	2	3	4	5
8.	I know precisely how closely the attending monitored the admission	1	2	3	4	5
9.	I felt the admission was intensively monitored by the attending	1	2	3	4	5
10.	The attending was an immediately available resource for this admission	1	2	3	4	5
11.	The attending showed high trust in the crew's ability to handled the admission	1	2	3	4	5

II. Crew behavior. Please circle the number that best corresponds to your opinion using the scale below.

1	2	3	4	5
To Little or No Extent	*To a Limited Extent*	*To Some Extent*	*To a Considerable Extent*	*To a Great Extent*

*To what extent did **each** of the following three crew members: (1) myself, (2) fellow/chief resident, and (3) the Attending Surgeon ...*	**Myself**					**Fellow/Chief Resident**					**Attending Surgeon**				
1. Tell others what strategy to use to treat the patient?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
2. Communicate an overall plan for the crew to follow?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
3. Actively participate in the resuscitation?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
4. Provide hands-on treatment of the patient?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
5. Teach others how to perform a task?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
6. Explain to others precisely how to perform a task?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
7. Oversee crewmembers' treatment of the patient?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
8. Watch the crew in order to prevent errors?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
9. Give credit when crewmembers did their job well?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
10. Express satisfaction when crewmembers did well?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
11. Remain calm throughout patient treatment?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
12. Remain composed and unflappable?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5

13. List briefly up to three goals of the team during the resuscitation

   a) _____

   b) _____

   c) _____

III. Task characteristics. Mark on the following analog scales of how you felt **during** the admission.

1. Stress. How much stress did you experience during the admission?

Not stressful 0 10 20 30 40 50 60 70 80 90 100 Extremely stressful

2. Time Pressure. Did you feel time pressure during the admission?

Low pressure 0 10 20 30 40 50 60 70 80 90 100 High pressure

3. Mental Effort. How intensive was your mental effort during the admission?

Low effort 0 10 20 30 40 50 60 70 80 90 100 High effort

IV. Crew activities. Please circle the number that best corresponds to your opinion using the scale below.

1 *Strongly Disagree*	2 *Disagree*	3 *Don't Agree or Disagree*	4 *Agree*	5 *Strongly Agree*

1.	Crewmembers coordinated their tasks in a smooth and orderly fashion.	1	2	3	4	5
2.	While treating the patient, crewmembers got in each other's way.	1	2	3	4	5
3.	Every crewmember had a shared understanding of the treatment plan.	1	2	3	4	5
4.	Crewmembers could anticipate each other's actions without being told.	1	2	3	4	5
5.	There was conflict among some members of the crew.	1	2	3	4	5
6.	There was obvious friction between some members of the crew.	1	2	3	4	5
7.	The team members agreed on all decisions and goals during this admission.	1	2	3	4	5
8.	I knew what all the other members of the team were trying to accomplish.	1	2	3	4	5
9.	I felt the need to intervene more than usual during this admission.	1	2	3	4	5
10.	The crew needed my direction more than usual.	1	2	3	4	5
11.	I learned new skills during this admission.	1	2	3	4	5
12.	I gained new information, insights, or abilities during this admission.	1	2	3	4	5
13.	I look forward to working again with the same crew.	1	2	3	4	5
14.	The crew developed a good sense of teamwork.	1	2	3	4	5
15.	All in all, the crew performed extremely well in treating the patient's injuries.	1	2	3	4	5

16. Think about the average performance of TRU crews in treating patients like this one. Compared to other TRU crews, how well did this crew perform in treating this patient? (Please circle the number)

1 *Greatly Below Average*	2 *Below Average*	3 *Average*	4 *Above Average*	5 *Greatly Above Average*

V. Experience. Please mark the box that best corresponds to your experience (not including current admission).

1. How many patients have you treated: (circle one):

…in the past 24 hours	0 patients	1-3 patients	4-6 patients	7-10 patients	11+ patients
…in your tenure at the TRU	0 patients	1-5 patients	6-10 patients	11-15 patients	20+ patients

2. In the past **24 hours**, how many patients have you treated *with the following people* (circle one):

Attending Surgeon	0 patients	1-3 patients	4-6 patients	7-10 patients	11+ patients
Surgical Fellow	0 patients	1-3 patients	4-6 patients	7-10 patients	11+ patients

3. In ***your tenure in the TRU*** how many patients have you treated with the *following people* (circle one):

Attending Surgeon	0 patients	1-5 patients	6-10 patients	11-15 patients	20+ patients
Surgical Fellow	0 patients	1-5 patients	6-10 patients	11-15 patients	20+ patients

On the following page are 132 words that describe moods and feelings. Please select any words that describe the way you felt during the admission. Check all words that describe your feelings. (Work rapidly)

Appendix G.

Pre- and Post-resuscitation questionnaires (PQ- and PRQ)forms for General participant

Post Resuscitation Questionnaire (PRQ)

This questionnaire is part of a study examining leadership. There are no right or wrong answers. Your answers will be completely confidential and voluntary. "Crew" refers to everyone involved.

Last 4 digit of your SSN: _____

I. Patient's injuries. Please circle the number that best corresponds to your opinion using the scale below.

1	2	3	4	5
Strongly Disagree	*Disagree*	*Don't Agree or Disagree*	*Agree*	*Strongly Agree*

1.	This admission required immediate resuscitative action upon arrival.	1	2	3	4	5
2.	We did not have a moment to spare in treating the patient's injuries.	1	2	3	4	5
3.	I have previously treated patients with injuries of this nature.	1	2	3	4	5
4.	In the TRU, we often see injuries of this sort.	1	2	3	4	5
5.	Soon after patient's arrival I knew precisely the patient status and condition.	1	2	3	4	5
6.	Differential diagnoses became clear to me immediately.	1	2	3	4	5

II. Crew behavior. Please circle the number that best corresponds to your opinion using the scale below.

1	2	3	4	5
To Little or No Extent	*To a Limited Extent*	*To Some Extent*	*To a Considerable Extent*	*To a Great Extent*

*To what extent did **each** of the following three crew members:*
(1) Admitting resident, (2) fellow/chief resident, and (3) the Attending Surgeon ...

	Admitting Resident					Fellow/Chief Resident					Attending Surgeon				
1. Tell others what strategy to use to treat the patient?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
2. Communicate an overall plan for the crew to follow?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
3. Actively participate in the resuscitation?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
4. Provide hands-on treatment of the patient?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
5. Teach others how to perform a task?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
6. Explain to others precisely how to perform a task?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
7. Oversee crewmembers' treatment of the patient?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
8. Watch the crew in order to prevent errors?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
9. Give credit when crewmembers did their job well?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
10. Express satisfaction when crewmembers did well?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
11. Remain calm throughout patient treatment?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
12. Remain composed and unflappable?	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5

III. Task characteristics. Mark on the following analog scales of how you felt **during** the admission.

1. Stress. How much stress did you experience during the admission?

Not stressful 0 10 20 30 40 50 60 70 80 90 100 Extremely stressful

2. Time Pressure. Did you feel time pressure during the admission?

Low pressure 0 10 20 30 40 50 60 70 80 90 100 High pressure

3. Mental Effort. How intensive was your mental effort during the admission?

Low effort 0 10 20 30 40 50 60 70 80 90 100 High effort

IV. Crew activities. Please circle the number that best corresponds to your opinion using the scale below.

1	2	3	4	5
Strongly Disagree	*Disagree*	*Don't Agree or Disagree*	*Agree*	*Strongly Agree*

1.	Crewmembers coordinated their tasks in a smooth and orderly fashion.	1	2	3	4	5
2.	While treating the patient, crewmembers got in each other's way.	1	2	3	4	5
3.	Every crewmember had a shared understanding of the treatment plan.	1	2	3	4	5
4.	Crewmembers could anticipate each other's actions without being told.	1	2	3	4	5
5.	There was conflict among some members of the crew.	1	2	3	4	5
6.	There was obvious friction between some members of the crew.	1	2	3	4	5
7.	The team members agreed on all decisions and goals during this admission.	1	2	3	4	5
8.	I knew what all the other members of the team were trying to accomplish.	1	2	3	4	5
9.	I felt the need to intervene more than usual during this admission.	1	2	3	4	5
10.	The crew needed my direction more than usual.	1	2	3	4	5
11.	I learned new skills during this admission.	1	2	3	4	5
12.	I gained new information, insights, or abilities during this admission.	1	2	3	4	5
13.	I look forward to working again with the same crew.	1	2	3	4	5
14.	The crew developed a good sense of teamwork.	1	2	3	4	5
15.	I was able to follow the communications among the crew very well.	1	2	3	4	5
16.	I was well informed about the plans and decisions regarding the admission.	1	2	3	4	5
17.	All in all, the crew performed extremely well in treating the patient's injuries.	1	2	3	4	5

18. Think about the average performance of TRU crews in treating patients like this one. Compared to other TRU crews, how well did this crew perform in treating this patient? (Please circle the number)

1	2	3	4	5
Greatly Below Average	*Below Average*	*Average*	*Above Average*	*Greatly Above Average*

V. Experience. Please mark the box that best corresponds to your experience (not including current admission).

1. How many patients have you treated: (circle one):

…in the past 24 hours	0 patients	1-3 patients	4-6 patients	7-10 patients	11+ patients
…in your tenure at the TRU	0 patients	1-5 patients	6-10 patients	11-15 patients	20+ patients

2. In the ***past 24 hours***, how many patients have you treated *with the following people* (circle one):

this Attending Surgeon	0 patients	1-3 patients	4-6 patients	7-10 patients	11+ patients
this admitting Resident	0 patients	1-3 patients	4-6 patients	7-10 patients	11+ patients
this Surgical Fellow	0 patients	1-3 patients	4-6 patients	7-10 patients	11+ patients

3. In ***your tenure in the TRU*** how many patients have you treated with the *following people* (circle one):

this Attending Surgeon	0 patients	1-5 patients	6-10 patients	11-15 patients	20+ patients
this admitting Resident	0 patients	1-5 patients	6-10 patients	11-15 patients	20+ patients
this Surgical Fellow	0 patients	1-5 patients	6-10 patients	11-15 patients	20+ patients

Appendix H.

Instructions for Post-resuscitation Video Review (PVR)

Instructions for PVR (Post-resuscitation video review)

As you watch the following video of the resuscitation, please comment on your thoughts at the time of the admission, as well as any noteworthy occurrences. These could include noteworthy actions by any of the resuscitation team members, the formation or implementation of treatment plans, treatment landmarks such as checking BP or auscultation of the chest, clearing the spine, etc. You should also feel free to comment on the successful communication or misunderstandings between members of the team, and any thoughts about the direction given by the attending, fellow or resident.

Appendix I.

MAACL scoring sheet

	A	D	H
	PA	SS	
1 ☐ active	45 ☐ fit		89 ☐ peaceful
2 ☐ adventurous	46 ☐ forlorn		90 ☐ pleased
3 ☐ affectionate	47 ☐ frank		91 ☐ pleasant
4 ☐ afraid	48 ☐ free		92 ☐ polite
5 ☐ agitated	49 ☐ friendly		93 ☐ powerful
6 ☐ agreeable	50 ☐ frightened		94 ☐ quiet
7 ☐ aggressive	51 ☐ furious		95 ☐ reckless
8 ☐ alive	52 ☐ lively		96 ☐ rejected
9 ☐ alone	53 ☐ gentle		97 ☐ rough
10 ☐ amiable	54 ☐ glad		98 ☐ sad
11 ☐ amused	55 ☐ gloomy		99 ☐ safe
12 ☐ angry	56 ☐ good		100 ☐ satisfied
13 ☐ annoyed	57 ☐ good-natured		101 ☐ secure
14 ☐ awful	58 ☐ grim		102 ☐ shaky
15 ☐ bashful	59 ☐ happy		103 ☐ shy
16 ☐ bitter	60 ☐ healthy		104 ☐ soothed
17 ☐ blue	61 ☐ hopeless		105 ☐ steady
18 ☐ bored	62 ☐ hostile		106 ☐ stubborn
19 ☐ calm	63 ☐ impatient		107 ☐ stormy
20 ☐ cautious	64 ☐ incensed		108 ☐ strong
21 ☐ cheerful	65 ☐ indignant		109 ☐ suffering
22 ☐ clean	66 ☐ inspired		110 ☐ sullen
23 ☐ complaining	67 ☐ interested		111 ☐ sunk
24 ☐ contented	68 ☐ irritated		112 ☐ sympathetic
25 ☐ contrary	69 ☐ jealous		113 ☐ tame
26 ☐ cool	70 ☐ joyful		114 ☐ tender
27 ☐ cooperative	71 ☐ kindly		115 ☐ tense
28 ☐ critical	72 ☐ lonely		116 ☐ terrible
29 ☐ cross	73 ☐ lost		117 ☐ terrified
30 ☐ cruel	74 ☐ loving		118 ☐ thoughtful
31 ☐ daring	75 ☐ low		119 ☐ timid
32 ☐ desperate	76 ☐ lucky		120 ☐ tormented
33 ☐ destroyed	77 ☐ mad		121 ☐ understanding
34 ☐ devoted	78 ☐ mean		122 ☐ unhappy
35 ☐ disagreeable	79 ☐ meek		123 ☐ unsociable
36 ☐ discontented	80 ☐ merry		124 ☐ upset
37 ☐ discouraged	81 ☐ mild		125 ☐ vexed
38 ☐ disgusted	82 ☐ miserable		126 ☐ warm
39 ☐ displeased	83 ☐ nervous		127 ☐ whole
40 ☐ energetic	84 ☐ obliging		128 ☐ wild
41 ☐ enraged	85 ☐ offended		129 ☐ willful
42 ☐ enthusiastic	86 ☐ outraged		130 ☐ wilted
43 ☐ fearful	87 ☐ panicky		131 ☐ worrying

Appendix J.

Observation form for non-recorded cases

Data Sheet for Distance Leadership Cases

Admission date	Time	Admission #	Doe Number	Bay #

Age	Gender	Type of injury	Mechanism of injury/ Vitals
			BP: HR: RR: O2: LOC: BS:

Participant	Name	Pre-admission		Immediately post			Post
		PQ(-)	saliva	MAACL	Saliva	PQR	PVR
Attending							
Fellow							
Resident in charge							
Resident supporting							
Anesthesia							
Anesthesia							
Nurse							
Nurse							

Please judge the percent of time the **Attending** was present for this case:

	Before Pt Arrives	When Pt Arrives	First 5 min	5-10 min	10-15 min
In Bay	0 25 50 75 100%	Yes No	0 25 50 75 100%	0 25 50 75 100%	0 25 50 75 100%
In TRU	0 25 50 75 100%	Yes No	0 25 50 75 100%	0 25 50 75 100%	0 25 50 75 100%

Please judge the percent of time the **Fellow** was present for this case:

	Before Pt Arrives	When Pt Arrives	First 5 min	5-10 min	10-15 min
In Bay	0 25 50 75 100%	Yes No	0 25 50 75 100%	0 25 50 75 100%	0 25 50 75 100%
In TRU	0 25 50 75 100%	Yes No	0 25 50 75 100%	0 25 50 75 100%	0 25 50 75 100%

Degree to which the **supporting resident** was present and active during the admission:

	Before Pt Arrives	When Pt Arrives	First 5 min	5-10 min	10-15 min
In Bay	0 25 50 75 100%	Yes No	0 25 50 75 100%	0 25 50 75 100%	0 25 50 75 100%

Other team actors in bay:

Resident:_____ Med Student_____ Anesthesia_____
Resident:_____ Nurse _____ Anesthesia_____
Resident:_____ Nurse _____ Anesthesia_____

Total number of people present in bay:

When Pt Arrives	First 5 min	5-10 min	10-15 min

Number of other patients in TRU when patient arrives:_____ Other active admissions Y / N

Appendix K.

Video-analysis plan

Video Analysis Plan
6/6/2001

Task characteristics. The task for a team during a session is primarily dependent on the type of patient. The following are measured:

1. Urgency
2. Novelty
3. Uncertainty
4. Risk
5. Workload
6. Stress

Leadership behavior (summary ratings).

1. Providing strategic direction
2. Providing hands-on treatment of the patient
3. Teaching
4. Monitoring team effectiveness
5. Providing contingent rewards
6. Remaining calm and composed

Leadership functions (moment to moment ratings). Types of leader involvement are

1. Surveying/monitoring
2. Obtaining information about patient and task status
3. Obtaining and critiquing reported plans
4. Providing technical instruction
5. Providing strategic guidance
6. Providing performance feedback/critique
7. Maintaining leader presence

Teamwork process. The process of the team during the admission.

1. Task coordination
2. Task prioritization
3. Communication
4. Shared awareness (status and goals)
5. Decisionmaking

Performance.

1. ATLS checklist (percentage of completed tasks appropriate for the patient)
2. Summary performance rating
3. Subjective ratings of timely performance
    a. Time to finish ABC (primary survey)
    b. Time to arrive at definitive diagnosis plan
4. Decisionmaking errors
5. Appropriateness of definitive diagnosis plan
6. Appropriateness of technical approach

Critical incident analysis. Provide comments on situations when

1. leadership is excellent or poor (needed but not provided)

2. teaching opportunity is not effectively exploited
3. coordination/communication is excellent or breaks down
4. excessive stress and workload occurs
5. patient status/injury is unusual

Appendix L.

Leadership Events Corpus

Time (m:s)	Key behavior	Description of behavior	Context
Tape 1: Pt is a 19 y/o male with multiple stab wounds to chest and back:Attending, fellow, and			
a new 2nd year resident: First day for team and fellow's second day in TRU.			
Patient HX of asthma: ISS of 19. Attending takes over admission.			
0:53	**leadership coaching**	fellow tells resident to shout out assessment so everyone can hear	resident is auscultating the patients lungs and there are multiple conversations occurring in the bay
1:35	**strategic plan / taking control by attending**	attending states priorities and strategic plan	team is asking pt's name and assessing pupils for neurological status meanwhile there are bleeding stab wounds in his back...attending points out that the stabwounds are in his back
1:58	**strategic plan / taking control by attending**	Attending takes over team	team is asking about allergies and does not seem to be well coordinated. It is obvious that the patient is laying in a pool of blood. Attending seems agitated at the pace of the admission
2:33	**strategic plan**	attending giving plan "put that there," etc referring to wipping blood off of back and assessing wounds	during log roll to further assess the wound location and depth...removes the bloody sheet from under the patient
2:40	**strategic plan**	attending communicating plan, "we're going to roll him..."	because he wants to fully assess all of the patient's stab wounds and control the bleeding, patient moaning during log roll
2:42	explicit request for info	attending inquiring about wound "how deep is that?"	
5:19	**strategic planning**	fellow talks about pt assessment with resident "we have 2 stab wounds we are worried about..."	together they prioritize and develop a general strategy, pt has weak pulses in upper and lower extremities, IV access established, O2 applied, head of bed at 60 degree angle to facilitate ventilation...they decide on sopecific x-rays

Time (m:s)	Key behavior	Description of behavior	Context
Tape 3: 27 y/o Female with abdominal stab wound (? Self inflicted). Fellow runs the admission			
1:08	maintaining team awareness	Attending letting fellow know he is listening and watching	
1:24	request for info	Attending asks resident to show wound	
2:12	request for info	Attending asks res about peritoneal signs	
3:37	**strategic planning / request for info**	Report by fellow to attending including pt mechanism of injury and status,	primary assessment complete, 5-6 cm knife, no peritoneal signs, fellow also inquires about info relating to where the patient came from because there is evidence of a fresh wound on pts chest potentially self-mutilation
4:07	FAST coaching	fellow bedside coaching resident	
4:45	Camera positioning	disucssion of FAST view and camera position	
5:15	request for info	attending can't see view, requests FAST report from Fellow	
5:45	FAST coaching	fellow bedside coaching resident	
6:38	communication problem with headsets	Communication problems with headset, worked out over a few minutes	
7:18	request for info	attending requests FAST report from Fellow, continual update	
7:40	maintaining team awareness	Attending tells fellow he's listening to everything she says	
8:23	Camera positioning	trying to use head-cam to see FAST image	
9:22	**report of plans by fellow**	fellow informs team member that they will need a CT of the patient's abdomen	Dx determined after acknowledging that examined injury is her only stab wound and FAST (neg) is complete
9:47	**coaching**	attending coaches fellow to check into computer	Check computer for a specific DPL (diagnostic peritoneal lavage) algorithm for the determination of intra-abdominal hemorrhage suggested for caring for this type of patient, pt covered and primary and secondary survey complete
10:14	team awareness	attending "I'm listening to you now" to resident	
10:20	request for info	attending "any blood" from resident "trauma handshake"	
10:48	request for info	requesting results of back exam plus response	
11:20	**strategic planning**	discussion of how to proceed with DPL in relation to fascal penetration between attending and fellow,	Fellow states protocol as in computer and proceeds to reexamine the depth of the wound, attending tries to describe how to effectively assess depending on location of the wound ie near the recutm etc., attending states that he will be out in a second to assess himself

Time (m:s)	Key behavior	Description of behavior	Context
Tape 6: 65 y/o male with car rolled over chest and legs; c/o chest pain and dyspnea; hx drug dependancy and appendectomy Attending, fellow, and medical student who fumbles a lot and needs guidance			
1:20	request for info	attending asks for repeat of paramedic report	
3:33	**strategic planning**	fellow discuss with resident the appropriate plan of care	Plan based on the assessment findings (good pulses, r leg pain and deformity, and LUQ pain) and after priortizing goals (need to do FAST soon to rule out any fluid in the abdomen). Pt is cooperative and c/o pain. Nurse and tech cutting off clothes and anesthesia securing face mask.
4:29	Camera positioning	positioning fast machine screen	
5:13	tutoring FAST	"you can's stand that way and do it upside down"	
6:00	Camera positioning	reposition head camera for better view	
6:49	tutoring FAST	"go up a rib space for better view of diaphragm"	
7:46	tutoring FAST	"go more posterior and toward the head"	
10:58	tutoring FAST	points out fluid line	
11:20	**strategic planning**	attending stresses the need to get a stat abdominal CT	As a result of the strategy, the team needs to focus on getting other things done first in order to get the patient to the CT scanner (FAST is nearly complete...2 positive fluid lines identified (kidney and bladder) with FAST) (he may need angio embolization of the spleen or the liver)
11:54	Camera positioning	attending asks for a better view of the injury with the head camera	
12:13	coaching fellow how to lead	you may want to scan his chest and belly soon	
13:49	**strategic planning**	fellow encourages the resident to plan on checking the patients neck and back prior to going to CT	Prior to this statement the resident is assessing and identifying the wounds on the patients legs (stable hemodynamically, bloods are being drawn, legs are numb)
14:48	**report of plans by fellow**	fellow states that they will plan to leave collar on even though clinically cleared	Leaves collar on because he wants to check patient's back first
16:36	**strategic planning**	attending informs fellow of the status of the CT machine and the need for a speedy assessment	CT status important because other patients are waiting for the machine however the patient needs to drink the contrast first (the team has 10-15 minutes to get to CT)
17:31	**maintaining team awareness**	fellow announces situation to team	Announcement made after attending updates the fellow about the CT schedule so the fellow relays the message/plan to the team
17:53	**strategic planning**	the resident is fumbling on what the plan should be	In response to resident's lack of knowledge, the fellow states the appropriate plan as being a chest x-ray, pelvis and legs

Time (m:s)	Key behavior	Description of behavior	Context
18:02	**critique of plans by attending**	that plan sounds good to me but suggests they decide on the blood work as well	Attending makes statement after the resident and fellow reveal plan of chest xray, pelvis, knee and tib/fib x-ray and then asked attending for feedback (they sent out type and cross, abg, myoglobin and ?? for bloodwork)

Time (m:s)	Key behavior	Description of behavior	Context
Tape 7:19 y/o male assaulted with a head laceration; Attending coachs and nearly takes over			
0:46	**maintaining team awareness**	assuring that the attending can hear the fellow and vice versa	
1:21	request for info	attending asks fellow to repeat the primary survey	
1:38	**coaching whole team**	fellow instructs team to shout out the primary survey	The resident is spending additional time discussing the patient with the paramedic so the fellow interrupts and stresses the need to move along so the attending can hear from the control room (resident is assessing lung sunds and nurse is exposing the patient)
1:50	maintaining team awareness	fellow verifies that attending can her the primary survey	
2:27	**coaching the fellow how to lead**	attending tells the fellow to remind the resident the steps in the primary survey	The resident is not performing the primary survey in the correct order. Resident had not formally assessed A B, and C
6:20	request for info	asks fellow what labs were just sent off	
6:49	maintaining team awareness	attending asks fellow "can you hear me know"	
6:57	request for info	attending asks fellow what the plans are	
7:17	**critique of plans by attending**	attending questions resident and fellow "does he even need a CBC"	The attending seems to feel that the resident and fellow may be ordering unnecessary labs (nurse I asking patient about allergies)
8:02	**coaching the fellow how to lead**	tells the fellow to tell nurse to not send off the labs	Attending mentions stopping the labs because the nurse will send routine but unnecessary labs as per their protocol if they do not intervene
9:54	**report of plans by fellow**	reports that they will get a head CT	Fellow states the reason why (due to lac with a step off, loss of consciousness and seizure) the head CT is needed and reiterates other findings (no tenderness in back cspine is clinically clear, not pelvis instability)
10:18	**critique of plans by attending**	confirms that plan sounds good	after fellow presents plan to the attending

Time (m:s)	Key behavior	Description of behavior	Context
Tape 17; 16 y/o male dirtbike accident; L ankle and thigh injuries; Attending pushes team to move faster			
2:16	**strategic planning**	fellow converses with nurse to determine when the FAST can be done	Decision based on when nurse plans to draw blood (pt exposed and plan on when to do FAST)
2:34	**coaching the fellow how to lead**	attending stresses that the primary survey should take about 30 seconds therefore the team is lagging	Attending states that she did not hear the primary survey…fellow responds that they are still doing it…(pt exposed, ABCDE done, assessing leg wounds)
3:24	request for camera positioning	asks fellow to turn the light source away for a better view	
4:01	**strategic planning**	fellow questions the residents plan for obtaining blood work then other steps	The fellow seems to be doing this to rush the process because the patient may need to go to the OR soon (still have not rolled or done FAST)(patient expresses extreme pain when they touch his leg wounds).
4:52	**coaching whole team**	fellow instructs team on ortho abilities with this type of injury	Apparently the plan of care is different for ortho patients.
5:19	**coaching the fellow how to lead**	attending reminds the fellow to tell the team that they will need to get AVI's	AVIs needed to determine if they need to angio the patient and call vascular
6:27	**fellow coaching resident**	fellow tells resident how to lead	"you should be giving orders…your running this…telling us what to do..you're the boss" the resident is assisting with dressing the leg wound and not running the team…he is assisting instead of leading
6:43	**strategic planning**	fellow reminds team the sequence of events that should happen:	Fellow wants to FAST and roll after the bloodwork has been drawn (meanwhile assessing and dressing leg wounds)
7:35	explicit requrst of camera positioning	attending asks fellow to ask resident to move his head	
9:33	tutoring FAST	fellow is helping resident with the FAST	
10:49	**report of plans by fellow**	fellow reports the results from the FAST and neck exam	Results of FAST are negative and neck is clinically clear. Fellow states that they are going to need to roll the pt now.

Time (m:s)	Key behavior	Description of behavior	Context
Tape 19: 35 ylo male with assault to head; Fellow runs team and resident does not wear headset			
2:03	**coaching team**	fellow is coaching resident to delegate tasks (difficult to hear)	Team exposing patient...A and B have clearly been done
4:26	request patient information	fellow questioning IV access	
5:07	**coaching resident**	fellow coaching resident to assess pt toes	Resident conducting neuro assessment for motor and sensation. It appears that the resident overlooked the lower extremities with the neuro assessment. Pt is exposed and appears to be in pain. Nurse is preparing to draw blood.
5:16	**strategic planning**	fellow tells team what the plan is in terms of IV access and FAST	Fellow wants to speed up the admission process. Nurse is actively applying the turnicate. FAST machine is in room and turned on
6:34	**coaching resident**	fellow coaches resident to inform patient what he is doing (FAST)	Warn the patient of FAST so the patient is not surprised from the pain. Nurse and medical student are attempting to draw blood.
7:24	request of camera positioning	fellow instructs resident to look at FAST screen so attending can get a better view	
8:10	tutoring FAST	fellow helps resident get a good view of heart	
8:57	maintaining team awareness	fellow is talking to attending trying to get a better connection	
9:04	**coaching resident**	fellow coaching resident to put headset on in order to hear the attending	Resident needs headset because he is missing the attending's instruction through the head set
9:21	tutoring FAST	fellow identifying kidney to resident who is doing the FAST	
11:01	request of information	attending asks resident what he has found so far	

Time (m:s)	Key behavior	Description of behavior	Context
Tape 21: 48 y/o male: MVC rollover; Attending does not intervene much			
1:47	maintaining team awareness	fellow asking if attending can hear him	
2:23	request of information	attending asks fellow what the status of the patient	
2:59	request of information	attending asks resident for primary survey	
3:53	**coaching resident**	attending coaches reisdent to choose the approproate labs before the nurses draw blood	Fellow needs to intervene with nurese because the nurse (who is currently drawing labs) may send unnecessary labs per their protocol
5:41	**report of plans by fellow**	"trying to get a line in, FAST, then roll him"	Fellow reports because the attending asked if they had rolled the pateint yet implying that they may be taking to long…IV has been placed, collar is being removed and FAST machine has been rolled into the room
5:47	**critique of plans by attending**	"sounds good to me"	Attending asks if they have rolled the pt yet so the fellow reports the plans as stated above
6:59	tutoring FAST	fellow tutoring secondary resident proper transducer placement	
7:31	tutoring FAST	attending tutoring resident and fellow	

Time (m:s)	Key behavior	Description of behavior	Context
Tape 23; 25 y/o Female, MVC with Closed Head Injury; April 2; Remote: minimal attending involvement			
2:47	request for info	fellow(?) asks resident to verbalize primary survey	
8:31	**report of plans requested by fellow (?)**	fellow asks resident "so what do you want to do" interms of plans for films	Following primary and secondary assessment including log roll, resident states that he just wants a chest and right shoulder x-ray.

Time (m:s)	Key behavior	Description of behavior	Context
Tape 24: 33 y/o Female in a MVC: Local			
1:06	*report patient information*	*resident anounces to team various vitals*	*During initial primary survey resident anounces his findings*
1:36	*request patient information*	*fellow asks resident if patient is responsive*	*During primary survey*
1:54	request of information	fellow inquires if the patient has an IV	
2:11	request of information	attending asks the resident about the patients main complaint	
3:19	tutoring FAST	fellow is tutoring resident while doing the FAST	
5:50	**report of plans by resident**	attending asks fellow about the plan who then asks the resident	It seems that the attending wants to make sure that whole team is all on the same page in terms of the plan. Cervical spine is currently being assessed then log roll is planned. ABCDE have been completed as well as FAST

Time (m:s)	Key behavior	Description of behavior	Context
Tape 26: 57 y/o male assault with pipe; translator needed			
1:30	**strategic planning**	fellow establishes that a translator will be needed	Team can not communicate with the patient because he speaks another language…A and B have been completed and CDE are underway
3:51	Explicit request of information	attending asks fellow patient information such as age mechanism of injury	

Time (m:s)	Key behavior	Description of behavior	Context
Tape 29: 20 y/o male struck by car; injury to arm and leg			
6:49	Explicit request of information	attending asks fellow patient information such as age and mechanism of injury	
7:26	Explicit request of information	attending inquiring about abdominal pain	
8:06	Explicit request of information	attending inquiring about pupils and head exam	
8:40	Explicit request of information	attending inquiring about back pain and if they are ready to roll him	
8:58	**strategic planning**	attending informing team the specific films that need to be done " T & L" (thorasic and lumbar)	Attending judgment based on the type of pain that the patient is complaining of (lower back pain)during the assessment. A B C D & E complete, no fast, and no log roll yet.

Time (m:s)	Key behavior	Description of behavior	Context
Tape #32: 30 y/o Male fell and struck head: Remote			
3:25	explicit request of information	attending asks resident about LOC and other patient findings	
4:41	maintaining team awareness	attending and fellow try to establish and maintain a connection	
8:35	Praise	attending tells resident he is doing well washing his hands	
12:53	maintaining team awareness	resident and attending establish connectivity	
13:11	Explicit request of information	attending asks resident what he has found so far	

Time (m:s)	Key behavior	Description of behavior	Context
Tape 37: 52 y/o Male in MVC: Local: Attending takes over the team			
1:35	Explicit request of information	attending asks team member (paramedic) to reiterate the pateint's past medical history	
2:00	Explicit request of information	attending asks resident for primary survey	
2:38	**coaching fellow how to lead**	attending tells fellow to jump in on the admission	Now that fellow is present in the bay, fellow can run the admission. There are 2 residents that are assessing the patient... ABC have been done. Residents are not communicating the assessment results
2:56	**taking over control of the team by attending**	attending reminds the team that the primary survey is A,B,C,D,E	Because residents are not communicating the assessment findings out loud, attending does not know if the assessment is being done.
4:49	Explicit request of information	attending asks team if the patient has a bruise by his neck	
6:06	**strategic planning**	attending tells team to call patient's cardiologist	The team has just asked the patient who his cardiologist is. The team needs to get detailed information about the pt's history and report the accident to the cardiologist
6:36	Explicit request of information	attending asks resident for secondary survey	
7:00	**taking control of team by attending**	attending informs resident that she has already ordered his labs	Attending takes charge perhaps because resident was taking too long. ABCDE is complete but no labs drawn, no logroll and no FAST has been done.
8:49	**coaching whole team**	attending recommends that the team covers up the patient to keep him warm	ABCDE assessment is complete and she wants them to hurry and do the FAST because she wants to move things along...IV is actively being placed
10:07	tutoring FAST	attending is tutoring the resident to do the FAST correctly	
13:28	**strategic planning**	attending announces the plan thus far and asks what the next steps will be	It seems that the attending wants to establish that the team has a thorough plan and survey to find out what additional interventions need to be done. FAST complete but not log roll.

Time (m:s)	Key behavior	Description of behavior	Context
Tape 38: 18 y/o Male in MVC: Remote: resident runs team, Resident runs team competently and attending questions/interferes with assessment			
0:33	Explicit request of information	attending wants to know what is wrong with the pateint's right arm	
0:48	maintaining team awareness	attending wants to know if the resident an hear him	
4:47	Explicit request of information	attending asks resident if the labs have been sent off yet	
7:06	updating attending	Resident: "are you seeing that, Dr (Attending)"	Resident making sure attending has reviewed the FAST exam and is satisfied with the results

Time (m:s)	Key behavior	Description of behavior	Context
Tape 39: 17 y/o Female (24 wks pregnant) that fell riding bike: Remote			
3:19	maintaining team awareness	attending asks fellow if he can hear him	
3:24	Explicit request of information	attending asks fellow for the basic patient information	
5:26	Explicit request of information	attending asks fellow how the FAST image is from in the bay because he cannot see it very well	
7:23	tutoring FAST	attending tells resident that she should be able to see the baby at 24 weeks	
9:21	Explicit request of information	attending asks team for their plan	

Time (m:s)	Key behavior	Description of behavior	Context
Tape 40: 20 y/o Male in MVC: Local: Attending close hands-on supervising			
2:32	teaching team members	attending is explaining that limitations of care ability because the residents are not trained in helecopter care	
3:57	**critique of plans by attending**	attending agreeing with fellows plan of head CT and FAST	Although it is difficult to hear the fellow's specific plans, you can see the attending nodding in agreement during the announcement of the plan and finally an agreement with the plan...ABCDE have been completed.
4:07	attending assessment of pt	attending actually assessing laceration and abdomen	
5:56	tutoring FAST	attending identifying spleen, kidney, and intercostal space	

Time (m:s)	Key behavior	Description of behavior	Context
Tape 48: 58 y/o Male that fell from 15 ft ladder: Remote: collective plan			
3:44	maintaining team awareness	attending asks resident to tell fellow to turn on headset when it beeps	
4:02	maintaining team awareness	attending and fellow are trying to maintain verbal communication	
5:15	**strategic planning**	resident reporting his plan...fellow adds to plan...then attending adds to plan	All three care providers (Attending, Fellow and Resident) seem to be contributing to the plan in order to make it comprehensive since several MD's participated in various portions of the assessment. ABCDE are done, but no log roll or FAST
5:21	**critique of plans by attending**	attending adds the need of a FAST to the resident and fellows plan	Attending adds FAST to plan, most likely due to pts type of injury and to ensure completeness of the plan of care
5:37	explicit request of camera positioning	attending asks resident to get a better look at the patients forehead so the attending can get a better look	

Time (m:s)	Key behavior	Description of behavior	Context
Tape 49: 45 y/o Male in MVC: Remote: fellow runs team			
1:34	Explicit request of information	fellow asks resident about the patients breath sounds	
2:01	Explicit request of information	fellow asks about IV status	
2:03	**strategic planning**	fellow instructs resident that the groin must be stuck for a central line	Central line is important because the patient is declining rapidly and has no IV access yet..A and B complete. Pt is agitated and struggling against team, and his resp status is deteriorating
2:45	Explicit request of information	fellow whats to know who is doing crichoid pressure	
2:59	**coaching whole team**	attending reminds group to inform the patient that he will feel a stick	Patient needs to be told to anticipate pain from a needle stick to avoid further agitation…pt is still extremely agitated and seems to be in enormous pain. Oxygenation provided by blow-by via bag valve mask. Multiple team members holding pt down.
3:08	tutoring central line placement	fellow instructs the resident to hold the needle very still when placing the line	
3:15	Explicit request of information	fellow asks team who has the oxygen set up	
3:16	Explicit request of information	fellow asks team if the fluids are ready	
3:31	tutoring resident	fellow asks resident to inform the patient that he will feel a stick	
8:29	**strategic planning**	fellow instructs the team that the patient needs to be repositioned	Pt needs to be repositioned because he is seems to be crooked on the stretcher. Pt intubated and central line placed. Pt sedated.
9:32	**strategic planning**	fellow delegates who will do the rectal exam and who will do the x-rays	perhaps to expidite the process and ensure that the team is working together..ABCDE complete…entubated, sedated, x-ray underway for accurate tube placement
11:03	Explicit request of information	attending requests the overall plan	
11:09	**report of plan by fellow**	fellow describes the findings from the patient assessment and what the team plans are	Fellow gives report after the attending asks for the fellows overall assessment and plan (difficult to hear entire plan)
11:16	maintaining team awareness	attending can not hear the fellows plan	
11:27	**report of plan by fellow**	fellow reiterates the plan	Fellow Restates plan because the attending was unable to hear due to the audio equipment. Plan includes an X-ray image of right chest and abdomen, and a FAST, then a CT scan of the head as well as chest and abdomen. The rest of team is trying to verify accurate ET-tube placement via auscultation, and is providing adequate sedation.
11:45	**critique of plans by attending**	attending acknowledges fellows plan	Attending acknowledges plan by telling him he is on the right track.

Time (m:s)	Key behavior	Description of behavior	Context
11:47	Explicit request of information	fellow asks attending if he would do anything different	
14:49	explicit request for information	attending wants to know what the patient x-rays look like	
17:18	tutoring FAST	fellow assisting with FAST	

Appendix M.

Leadership behavior impact and frequency questionnaire content

LEADERSHIP FREQUENCY AND IMPACT SURVEY
RESULTS

➢ **The scale for the** frequency **items is the following:**

[1] Not at all common: I *rarely* observe this leader behavior.
[2] A little common: I *occasionally* observe this leader behavior.
[3] Somewhat common: I *sometimes* observe this leader behavior.
[4] Very common: I *often* observe this leader behavior.
[5] Extremely common: I *usually* observe this leader behavior.

➢ **The scale for the** impact **items is the following:**

[1] A negative impact.
[2] No impact.
[3] A slightly positive impact.
[4] A moderately positive impact.
[5] A very positive impact.

Data are presented in the following order:

- frequency **leadership descriptive statistics for** items **in the question number order that they appear in the survey.**
- frequency **leadership descriptive statistics for** items **in rank mean order with the largest means at the top and the smallest means at the bottom.**
- impact **leadership descriptive statistics for** items **in the question number order that they appear in the survey.**
- impact **leadership descriptive statistics for** items **in rank mean order with the largest means at the top and the smallest means at the bottom.**
- frequency **leadership descriptive statistics for** constructs **in rank mean order with the largest means at the top and the smallest means at the bottom as well as presenting** reliabilities **for each construct.**
- impact **leadership descriptive statistics for** constructs **in rank mean order with the largest means at the top and the smallest means at the bottom as well as presenting** reliabilities **for each construct.**
- **participants' responses to all of the** write-in questions. **All responses are verbatim.**

FREQUENCY LEADERSHIP DESCRIPTIVE STATISTICS IN QUESTION NUMBER ORDER

Frequency Leadership Descriptive Statistics

	N	Min	Max	Mean	SD
Q2 Express confidence that the crew will perfrom well	17	1	5	3.00	1.37
Q3 Talk enthusiastically about what needs to be accomplished	17	1	5	3.29	1.16
Q4 Seek differing perspectives when treating the patient	17	1	5	2.94	1.30
Q5 Get the crew to consider different treatment options for the patient	17	1	5	3.35	1.06
Q6R Remain calm throughout patient treatment	8	1	5	3.75	1.16
Q7R Be composed and unflappable	8	2	5	4.00	.93
Q8R Speak to other crew members in an unexcited manner	8	2	5	4.00	.93
Q9 Give credit to members of the crew when they do their job well	17	1	5	3.06	1.34
Q10 Express satisfaction with members of the crew when they do a good job	17	1	5	3.18	1.29
Q11 From an opinion regarding the severity of the patient's injuries	17	4	5	4.65	.49
Q12 Focus attention on irregularities, mistakes, exceptions, and deviations from standards	17	1	5	3.24	1.15
Q13R Be anxious during patient treatment	8	1	3	2.00	.76
Q14R Express excitement during patient treatment	8	1	3	2.38	.74
Q15 Tell members of the crew what they have done wrong rather than what they have done right	17	1	4	2.24	.90
Q16 Be absent when needed	16	1	5	2.31	1.30
Q17 Avoid making decisions	17	1	4	2.06	1.20
Q18 Determine priorities for different activies and plan an appropriate allocation of available resources among the activities	17	2	5	3.94	.90
Q19 Plan in detail how to accomplish a major task or project (e.g., identify necessary action steps, when each should be done, and who should do it)	17	2	5	3.53	.80
Q20 Raise his/her voice at a patient	17	1	4	1.71	.85
Q21 Clearly explain crew members' responsibilities in treating the patient	17	1	4	3.00	1.00
Q22 Clarify roles and objectives to crew members	17	1	5	3.41	1.00
Q23 Consult with crew members to get their reactions and/or suggestions	17	1	5	3.00	1.06
Q24 Encourage crew members to express any concerns or doubts about the plan for diagnosing and treating the patient	17	1	4	2.47	1.18
Q25 Seek information from crew members in order to determine the course of action	17	1	5	3.41	1.06
Q26 Develop enthusiasm by appealing to crew members' pride in accomplishing a challenging task	17	1	4	2.47	1.07
Q27 Describe an inspiring vision of what can be accomplished with cooperation adn support fromt he crew	17	1	4	2.41	1.12
Q28 Compliment crew members for demonstrating unusual skill in performing a task	17	1	5	3.12	1.27
Q29 Express personal appreciation for crew memebers who display special effort	17	1	5	2.94	1.20
Q30 Recognize the work and accomplishments of crew members	17	1	4	2.82	1.01
Q31 Check on the quality of work	17	3	5	3.65	.70
Q32 Pay attention to the patient	17	2	5	3.88	.78
Q33 Check work progress agaisnt plans to see if it is on target	17	1	5	3.71	1.05
Q34 Monitor the work of crew members	17	1	5	3.24	1.15
Q35 Identify constraints preventing effective treatment and find ways to elimate or circumvent them	17	2	5	3.53	.87
Q36 Handle treatment-related problems and creises in a confident and decisive manner	16	2	5	3.94	.93
Q37 Solve problems relating to the treatment of paitents	17	3	5	4.06	.75
Q38 Give crew members encouragement and support when they had a difficult and stresseful task to do	17	1	5	2.94	1.03
Q39 Be sympathetic and supportive when crew members are worried or upset	17	1	5	2.53	1.37
Q40 Be present at the start of treatment	17	2	5	3.76	.97
Q41 Propose a reasonable compromise to resolve a disagreement	17	1	5	3.24	.97
Q42 Attempt to resolve conflict between crew members	17	1	5	3.18	1.38
Q43 Delgate to crew members the authority to make important decisions and implement them without hsi/her approval	17	1	5	2.71	1.26
Q44 Encourage crew members to determine for themselves the best way to carry out an assignment or accomplish an objective	17	1	5	3.12	.99
Q45 Ask a crew member to perfrom a specific task	17	2	5	3.88	.86
Q46 Direct crew members to carry out a specific task	17	3	5	3.82	.73
Q47 Tell crew members what to do	17	2	5	3.71	.92
Q48 Monitor crew members' actions to be sure that the patient receives appropriate care	17	2	5	3.65	1.00
Q49 Oversee crew members' treatment of the patient	17	2	5	3.82	1.01
Q50 Watch the crew in order to prevent errors in their treatment of hte patient	17	2	5	3.76	.90
Q51 Set goals and priorities for treating the patient	17	3	5	4.29	.69
Q52 Provide a general game plan for the treatment of the patient	17	2	5	4.24	.75
Q53 Tell the crew what strategy to use in treating the patient	17	2	5	3.88	.86
Q54 Communicate an overall plan for the crew to follow in treating the patient's injuries	17	3	5	3.88	.49
Q55 Decide what tests or treatments the patient should receive	17	3	5	4.24	.66
Q56 Teach one or more crew members how to perform a task	17	2	5	3.65	.79
Q57 Explain to one or more crew members precisely how to perform a specific task	17	2	5	3.41	.94
Q58 Train crew members to perform specific tasks	17	2	5	3.41	.87
Q59 Actively participate in treating the patient	17	2	5	3.76	.90
Q60 Provide hands-on treatment of the patient	16	2	5	3.50	.82
Valid N (listwise)	7				

FREQUENCY LEADERSHIP DESCRIPTIVE STATISTICS IN MEAN RANK ORDER

Frequency Leadership Descriptive Statistics

	N	Min	Max	Mean	SD
Q11 From an opinion regarding the severity of the patient's injuries	17	4	5	4.65	.49
Q51 Set goals and priorities for treating the patient	17	3	5	4.29	.69
Q55 Decide what tests or treatments the patient should receive	17	3	5	4.24	.66
Q52 Provide a general game plan for the treatment of the patient	17	2	5	4.24	.75
Q37 Solve problems relating to the treatment of paitents	17	3	5	4.06	.75
Q8R Speak to other crew members in an unexcited manner	8	2	5	4.00	.93
Q7R Be composed and unflappable	8	2	5	4.00	.93
Q18 Determine priorities for different activies and plan an appropriate allocation of available resources among the activities	17	2	5	3.94	.90
Q36 Handle treatment-related problems and creises in a confident and decisive manner	16	2	5	3.94	.93
Q54 Communicate an overall plan for the crew to follow in treating the patient's injuries	17	3	5	3.88	.49
Q45 Ask a crew member to perfrom a specific task	17	2	5	3.88	.86
Q32 Pay attention to the patient	17	2	5	3.88	.78
Q53 Tell the crew what strategy to use in treating the patient	17	2	5	3.88	.86
Q49 Oversee crew members' treatment of the patient	17	2	5	3.82	1.01
Q46 Direct crew members to carry out a specific task	17	3	5	3.82	.73
Q50 Watch the crew in order to prevent errors in their treatment of hte patient	17	2	5	3.76	.90
Q40 Be present at the start of treatment	17	2	5	3.76	.97
Q59 Actively participate in treating the patient	17	2	5	3.76	.90
Q6R Remain calm throughout patient treatment	8	1	5	3.75	1.16
Q47 Tell crew members what to do	17	2	5	3.71	.92
Q33 Check work progress agaisnt plans to see if it is on target	17	1	5	3.71	1.05
Q48 Monitor crew members' actions to be sure that the patient receives appropriate care	17	2	5	3.65	1.00
Q31 Check on teh quality of work	17	3	5	3.65	.70
Q56 Teach one or more crew members how to perform a task	17	2	5	3.65	.79
Q19 Plan in detail how to accomplish a major task or project (e.g., identify necessary action steps, when each should be done, and who should do it)	17	2	5	3.53	.80
Q35 Identify constraints preventing effective treatment and find ways to elimate or circumvent them	17	2	5	3.53	.87
Q60 Provide hands-on treatment of the patient	16	2	5	3.50	.82
Q58 Train crew members to perform specific tasks	17	2	5	3.41	.87
Q57 Explain to one or more crew members precisely how to perform a specific task	17	2	5	3.41	.94
Q22 Clarify roles and objectives to crew members	17	1	5	3.41	1.00
Q25 Seek information from crew members in order to determine the course of action	17	1	5	3.41	1.06
Q5 Get the crew to consider different treatment options for the patient	17	1	5	3.35	1.06
Q3 Talk enthusiastically about what needs to be accomplished	17	1	5	3.29	1.16
Q41 Propose a reasonable compromise to resolve a disagreement	17	1	5	3.24	.97
Q34 Monitor the work of crew members	17	1	5	3.24	1.15
Q12 Focus attention on irregularities, mistakes, exceptions, and deviations from standards	17	1	5	3.24	1.15
Q42 Attempt to resolve conflict between crew members	17	1	5	3.18	1.38
Q10 Express satisfaction with members of the crew when they do a good job	17	1	5	3.18	1.29
Q44 Encourage crew members to determine for themselves the best way to carry out an assignment or accomplish an objective	17	1	5	3.12	.99
Q28 Compliment crew members for demonstrating unusual skill in performing a task	17	1	5	3.12	1.27
Q9 Give credit to members of the crew when they do their job well	17	1	5	3.06	1.34
Q2 Express confidence that the crew will perfrom well	17	1	5	3.00	1.37
Q23 Consult with crew members to get their reactions and/or suggestions	17	1	5	3.00	1.06
Q21 Clearly explain crew members' responsibilities in treating the patient	17	1	4	3.00	1.00
Q29 Express personal appreciation for crew memebers who display special effort	17	1	5	2.94	1.20
Q4 Seek differing perspectives when treating the patient	17	1	5	2.94	1.30
Q38 Give crew members encouragement and support when they had a difficult and stresseful task to do	17	1	5	2.94	1.03
Q30 Recognize the work and accomplishments of crew members	17	1	4	2.82	1.01
Q43 Delgate to crew members the authority to make important decisions and implement them without hsi/her approval	17	1	5	2.71	1.26
Q39 Be sympathetic and supportive when crew members are worried or upset	17	1	5	2.53	1.37
Q24 Encourage crew members to express any concerns or doubts about the plan for diagnosing and treating the patient	17	1	4	2.47	1.18
Q26 Develop enthusiasm by appealing to crew members' pride in accomplishing a challenging task	17	1	4	2.47	1.07
Q27 Describe an inspiring vision of what can be accomplished with cooperation adn support fromt he crew	17	1	4	2.41	1.12
Q14R Express excitement during patient treatment	8	1	3	2.38	.74
Q16 Be absent when needed	16	1	5	2.31	1.30
Q15 Tell members of the crew what they have done wrong rather than what they have done right	17	1	4	2.24	.90
Q17 Avoid making decisions	17	1	4	2.06	1.20
Q13R Be anxious during patient treatment	8	1	3	2.00	.76
Q20 Raise his/her voice at a patient	17	1	4	1.71	.85
Valid N (listwise)	7				

IMPACT LEADERSHIP DESCRIPTIVE STATISTICS IN QUESTION NUMBER ORDER

Impact Leadership Descriptive Statistics

	N	Min	Max	Mean	SD
Q2 Express confidence that the crew will perfrom well	18	2	5	4.00	.77
Q3 Talk enthusiastically about what needs to be accomplished	18	3	5	3.89	.76
Q4 Seek differing perspectives when treating the patient	18	1	5	3.39	1.14
Q5 Get the crew to consider different treatment options for the patient	18	2	5	3.61	.98
Q6R Remain calm throughout patient treatment	9	3	5	4.44	.73
Q7R Be composed and unflappable	9	2	5	4.00	1.00
Q8R Speak to other crew members in an unexcited manner	8	1	5	3.38	1.19
Q9 Give credit to members of the crew when they do their job well	18	3	5	4.00	.77
Q10 Express satisfaction with members of the crew when they do a good job	18	2	5	4.00	.77
Q11 From an opinion regarding the severity of the patient's injuries	17	3	5	4.41	.71
Q12 Focus attention on irregularities, mistakes, exceptions, and deviations from standards	17	1	5	2.82	1.13
Q13R Be anxious during patient treatment	9	1	2	1.33	.50
Q14R Express excitement during patient treatment	8	1	4	2.63	1.06
Q15 Tell members of the crew what they have done wrong rather than what they have done right	18	1	4	2.00	.97
Q16 Be absent when needed	18	1	3	1.17	.51
Q17 Avoid making decisions	18	1	3	1.39	.70
Q18 Determine priorities for different activies and plan an appropriate allocation of available resources among the activities	18	2	5	3.94	.87
Q19 Plan in detail how to accomplish a major task or project (e.g., identify necessary action steps, when each should be done, and who should do it)	17	1	5	3.59	1.12
Q20 Raise his/her voice at a patient	17	1	3	1.71	.77
Q21 Clearly explain crew members' responsibilities in treating the patient	17	2	5	3.76	1.03
Q22 Clarify roles and objectives to crew members	17	3	5	4.00	.71
Q23 Consult with crew members to get their reactions and/or suggestions	18	1	5	3.50	.92
Q24 Encourage crew members to express any concerns or doubts about the plan for diagnosing and treating the patient	18	1	5	3.44	.98
Q25 Seek information from crew members in order to determine the course of action	18	2	5	3.67	.84
Q26 Develop enthusiasm by appealing to crew members' pride in accomplishing a challenging task	18	2	5	3.83	1.04
Q27 Describe an inspiring vision of what can be accomplished with cooperation adn support fromt he crew	16	1	5	3.19	1.05
Q28 Compliment crew members for demonstrating unusual skill in performing a task	18	2	5	3.72	1.07
Q29 Express personal appreciation for crew memebers who display special effort	18	2	5	3.94	.80
Q30 Recognize the work and accomplishments of crew members	18	2	5	4.00	.84
Q31 Check on teh quality of work	18	3	5	4.11	.76
Q32 Pay attention to the patient	18	3	5	4.44	.62
Q33 Check work progress agaisnt plans to see if it is on target	18	3	5	4.33	.69
Q34 Monitor the work of crew members	18	3	5	4.06	.80
Q35 Identify constraints preventing effective treatment and find ways to elimate or circumvent them	17	3	5	4.29	.77
Q36 Handle treatment-related problems and creises in a confident and decisive manner	18	3	5	4.44	.62
Q37 Solve problems relating to the treatment of paitents	18	4	5	4.44	.51
Q38 Give crew members encouragement and support when they had a difficult and stresseful task to do	18	3	5	4.11	.58
Q39 Be sympathetic and supportive when crew members are worried or upset	18	2	5	3.61	.78
Q40 Be present at the start of treatment	18	2	5	3.89	.90
Q41 Propose a reasonable compromise to resolve a disagreement	18	2	5	3.72	.89
Q42 Attempt to resolve conflict between crew members	18	2	5	3.78	1.06
Q43 Delgate to crew members the authority to make important decisions and implement them without hsi/her approval	16	1	5	3.25	1.18
Q44 Encourage crew members to determine for themselves the best way to carry out an assignment or accomplish an objective	18	1	5	3.17	1.34
Q45 Ask a crew member to perfrom a specific task	17	2	5	3.59	.94
Q46 Direct crew members to carry out a specific task	17	3	5	3.82	.81
Q47 Tell crew members what to do	17	2	5	3.18	.81
Q48 Monitor crew members' actions to be sure that the patient receives appropriate care	18	3	5	4.06	.73
Q49 Oversee crew members' treatment of the patient	18	2	5	4.06	.80
Q50 Watch the crew in order to prevent errors in their treatment of hte patient	18	1	5	3.83	1.10
Q51 Set goals and priorities for treating the patient	18	3	5	4.28	.57
Q52 Provide a general game plan for the treatment of the patient	18	3	5	4.28	.67
Q53 Tell the crew what strategy to use in treating the patient	17	2	5	4.06	.90
Q54 Communicate an overall plan for the crew to follow in treating the patient's injuries	17	3	5	4.35	.70
Q55 Decide what tests or treatments the patient should receive	17	2	5	3.76	.97
Q56 Teach one or more crew members how to perform a task	17	1	5	3.71	1.10
Q57 Explain to one or more crew members precisely how to perform a specific task	17	1	5	3.53	1.01
Q58 Train crew members to perform specific tasks	18	3	5	3.89	.68
Q59 Actively participate in treating the patient	18	1	5	3.56	1.04
Q60 Provide hands-on treatment of the patient	17	1	5	3.59	1.00
Valid N (listwise)	7				

IMPACT LEADERSHIP DESCRIPTIVE STATISTICS IN MEAN RANK ORDER

Impact Leadership Descriptive Statistics

	N	Min	Max	Mean	SD
Q37 Solve problems relating to the treatment of patients	18	4	5	4.44	.51
Q36 Handle treatment-related problems and creises in a confident and decisive manner	18	3	5	4.44	.62
Q32 Pay attenbon to the patient	18	3	5	4.44	.62
Q6R Remain calm throughout patient treatment	9	3	5	4.44	.73
Q11 From an opinion regarding the severity of the patient's injuries	17	3	5	4.41	.71
Q54 Communicate an overall plan for the crew to follow in treating the patient's injuries	17	3	5	4.35	.70
Q33 Check work progress against plans to see if it is on target	18	3	5	4.33	.69
Q35 Identify constraints preventing effective treatment and find ways to elimate or circumvent them	17	3	5	4.29	.77
Q51 Set goals and priorities for treating the patient	18	3	5	4.28	.57
Q52 Provide a general game plan for the treatment of the patient	18	3	5	4.28	.67
Q38 Give crew members encouragement and support when they had a difficult and stresseful task to do	18	3	5	4.11	.58
Q31 Check on teh quality of work	18	3	5	4.11	.76
Q53 Tell the crew what strategy to use in treating the patient	17	2	5	4.06	.90
Q49 Oversee crew members' treatment of the patient	18	2	5	4.06	.80
Q48 Monitor crew members' actions to be sure that the patient receives appropriate care	18	3	5	4.06	.73
Q34 Monitor the work of crew members	18	3	5	4.06	.80
Q30 Recognize the work and accomplishments of crew members	18	2	5	4.00	.84
Q22 Clarify roles and objectives to crew members	17	3	5	4.00	.71
Q10 Express satisfaction with members of the crew when they do a good job	18	2	5	4.00	.77
Q9 Give credit to members of the crew when they do their job well	18	3	5	4.00	.77
Q7R Be composed and unflappable	9	2	5	4.00	1.00
Q2 Express confidence that the crew will perfrom well	18	2	5	4.00	.77
Q29 Express personal appreciation for crew memebers who display special effort	18	2	5	3.94	.80
Q18 Determine priorities for different activies and plan an appropriate allocation of available resources among the activities	18	2	5	3.94	.87
Q40 Be present at the start of treatment	18	2	5	3.89	.90
Q3 Talk enthusiastically about what needs to be accomplished	18	3	5	3.89	.76
Q58 Train crew members to perform specific tasks	18	3	5	3.89	.68
Q26 Develop enthusiasm by appealing to crew members' pride in accomplishing a challenging task	18	2	5	3.83	1.04
Q50 Watch the crew in order to prevent errors in their treatment of hte patient	18	1	5	3.83	1.10
Q46 Direct crew members to carry out a specific task	17	3	5	3.82	.81
Q42 Attempt to resolve conflict between crew members	18	2	5	3.78	1.06
Q55 Decide what tests or treatments the patient should receive	17	2	5	3.76	.97
Q21 Clearly explain crew members' responsibilities in treating the patient	17	2	5	3.76	1.03
Q28 Compliment crew members for demonstrating unusual skill in performing a task	18	2	5	3.72	1.07
Q41 Propose a reasonable compromise to resolve a disagreement	18	2	5	3.72	.89
Q56 Teach one or more crew members how to perform a task	17	1	5	3.71	1.10
Q25 Seek information from crew members in order to determine the course of action	18	2	5	3.67	.84
Q5 Get the crew to consider different treatment options for the patient	18	2	5	3.61	.98
Q39 Be sympathetic and supportive when crew members are worned or upset	18	2	5	3.61	.78
Q60 Provide hands-on treatment of the patient	17	1	5	3.59	1.00
Q45 Ask a crew member to perfrom a specific task	17	2	5	3.59	.94
Q19 Plan in detail how to accomplish a major task or project (e.g., identify necessary action steps, when each should be done, and who should do it)	17	1	5	3.59	1.12
Q59 Actively participate in treating the patient	18	1	5	3.56	1.04
Q57 Explain to one or more crew members precisely how to perform a specific task	17	1	5	3.53	1.01
Q23 Consult with crew members to get their reactions and/or suggestions	18	1	5	3.50	.92
Q24 Encourage crew members to express any concerns or doubts about the plan for diagnosing and treating the patient	18	1	5	3.44	.98
Q4 Seek differing perspectives when treating the patient	18	1	5	3.39	1.14
Q8R Speak to other crew members in an unexcited manner	8	1	5	3.38	1.19
Q43 Delgate to crew members the authority to make important decisions and implement them without his/her approval	16	1	5	3.25	1.18
Q27 Describe an inspiring vision of what can be accomplished with cooperation adn support fromt he crew	16	1	5	3.19	1.05
Q47 Tell crew members what to do	17	2	5	3.18	.81
Q44 Encourage crew members to determine for themselves the best way to carry out an assignment or accomplish an objective	18	1	5	3.17	1.34
Q12 Focus attention on irregularities, mistakes, exceptions, and deviations from standards	17	1	5	2.82	1.13
Q14R Express excitement during patient treatment	8	1	4	2.63	1.06
Q15 Tell members of the crew what they have done wrong rather than what they have done right	18	1	4	2.00	.97
Q20 Raise his/her voice at a patient	17	1	3	1.71	.77
Q17 Avoid making decisions	18	1	3	1.39	.70
Q13R Be anxious during patient treatment	9	1	2	1.33	.50
Q16 Be absent when needed	18	1	3	1.17	.51
Valid N (listwise)	7				

FREQUENCY LEADERSHIP CONSTRUCT DESCRIPTIVE STATISTICS IN MEAN RANK ORDER

Frequency Leadership Construct Descriptive Statistics

	N	Minimum	Maximum	Mean	SD
OC_S Own Construct Strategizing (Q51, Q52, Q53, Q54, Q55)	17	2.80	5.00	4.1059	.5105
OC_CC Own Construct Calm and Composed (Q6r, Q7r, Q8r, Q13r reverse, Q14r reverse	8	2.20	4.80	3.8750	.8137
MPS_PS MPS Problem Solving (Q35, Q36, Q37)	17	2.67	4.67	3.8333	.6614
OC_DB Own Construct Directive Behavior (Q45, Q46, Q47)	17	2.67	5.00	3.8039	.6878
OC_M Own Construct Monitoring (Q48, Q49, Q50)	17	2.00	5.00	3.7451	.8939
MPS_PO MPS Planning and Organizing (Q18, Q19)	17	2.00	5.00	3.7353	.7524
OC_HO Own Construct Hands-On (Q59, Q60)	17	2.00	5.00	3.6765	.8650
MPS_M MPS Monitoring (Q31, Q33, Q34)	17	1.67	5.00	3.5294	.8584
OC_T Own Construct Teaching (Q56, Q57, Q58)	17	2.33	5.00	3.4902	.7557
MPS_MC MPS Managing Conflict (Q41, Q42)	17	1.50	5.00	3.2059	1.0009
MPS_CRO MPS Clarifying Roles and Objectives (Q21, Q22)	17	1.00	4.50	3.2059	.8849
MLQ_TRAN MLQ Transformational (Q2, Q3, Q4, Q5)	17	1.75	4.75	3.1471	.9440
MLQ_CR MLQ Contingent Rewards (Q9, Q10)	17	1.00	5.00	3.1176	1.2934
MPS_C MPS Consulting (Q23, Q24, Q25)	17	1.33	4.67	2.9608	.9419
MPS_R MPS Recognizing (Q28, Q29, Q30)	17	1.00	4.67	2.9608	1.1048
MPS_D MPS Delegating (Q43, Q44)	17	1.50	5.00	2.9118	.9880
MLQ_MBE MLQ Management by Exception (Q12, Q15)	17	1.00	4.00	2.7353	.7929
MPS_S MPS Supporting (Q38, Q39)	17	1.00	5.00	2.7353	1.1197
MPS_MI MPS Motivating and Inspiring (Q26, Q27)	17	1.00	4.00	2.4412	1.0736
MLQ_LF MLQ Laissez-Faire (Q16, Q17)	17	1.00	4.00	2.1471	.9805
Valid N (listwise)	8				

Reliability for Frequency Scales

	Reliability for Scales = Alpha
OC_S Own Construct Strategizing (Q51, Q52, Q53, Q54, Q55)	.7802
OC_CC Own Construct Calm and Composed (Q6r, Q7r, Q8r, Q13r reverse, Q14r reverse	.9331
MPS_PS MPS Problem Solving (Q35, Q36, Q37)	.6811
OC_DB Own Construct Directive Behavior (Q45, Q46, Q47)	.7565
OC_M Own Construct Monitoring (Q48, Q49, Q50)	.9080
MPS_PO MPS Planning and Organizing (Q18, Q19)	.7208
OC_HO Own Construct Hands-On (Q59, Q60)	.9397
MPS_M MPS Monitoring (Q31, Q33, Q34)	.8431
OC_T Own Construct Teaching (Q56, Q57, Q58)	.8412
MPS_MC MPS Managing Conflict (Q41, Q42)	.5798
MPS_CRO MPS Clarifying Roles and Objectives (Q21, Q22)	.7183
MLQ_TRAN MLQ Transformational (Q2, Q3, Q4, Q5)	.7702
MLQ_CR MLQ Contingent Rewards (Q9, Q10)	.9648
MPS_C MPS Consulting (Q23, Q24, Q25)	.8149
MPS_R MPS Recognizing (Q28, Q29, Q30)	.9438
MPS_D MPS Delegating (Q43, Q44)	.6780
MLQ_MBE MLQ Management by Exception (Q12, Q15)	.3041
MPS_S MPS Supporting (Q38, Q39)	.8240
MPS_MI MPS Motivating and Inspiring (Q26, Q27)	.9601
MLQ_LF MLQ Laissez-Faire (Q16, Q17)	.3128
Valid N (listwise)	8

IMPACT LEADERSHIP CONSTRUCT DESCRIPTIVE STATISTICS IN MEAN RANK ORDER

Impact Leadership Construct Descriptive Statistics

	N	Minimum	Maximum	Mean	SD
MPS_PS MPS Problem Solving (Q35, Q36, Q37)	18	3.33	5.00	4.3889	.5270
MPS_M MPS Monitoring (Q31, Q33, Q34)	18	3.33	5.00	4.1667	.5968
OC_S Own Construct Strategizing (Q51, Q52, Q53, Q54, Q55)	18	3.00	5.00	4.1444	.5893
OC_CC Own Construct Calm and Composed (Q6r, Q7r, Q8r, Q13r reverse, Q14r reverse	9	3.00	5.00	4.0148	.5905
MLQ_CR MLQ Contingent Rewards (Q9, Q10)	18	2.50	5.00	4.0000	.7276
OC_M Own Construct Monitoring (Q48, Q49, Q50)	18	2.00	5.00	3.9815	.8203
MPS_R MPS Recognizing (Q28, Q29, Q30)	18	2.00	5.00	3.8889	.8245
MPS_CRO MPS Clarifying Roles and Objectives (Q21, Q22)	17	2.50	5.00	3.8824	.8202
MPS_S MPS Supporting (Q38, Q39)	18	2.50	5.00	3.8611	.5893
MPS_PO MPS Planning and Organizing (Q18, Q19)	18	2.50	5.00	3.7778	.7519
MPS_MC MPS Managing Conflict (Q41, Q42)	18	2.00	5.00	3.7500	.8445
MLQ_TRAN MLQ Transformational (Q2, Q3, Q4, Q5)	18	2.25	5.00	3.7222	.7371
OC_T Own Construct Teaching (Q56, Q57, Q58)	18	1.67	5.00	3.7222	.8498
MPS_MI MPS Motivating and Inspiring (Q26, Q27)	18	1.50	5.00	3.5833	.9739
MPS_C MPS Consulting (Q23, Q24, Q25)	18	1.67	5.00	3.5370	.7850
OC_DB Own Construct Directive Behavior (Q45, Q46, Q47)	17	2.33	5.00	3.5294	.6568
OC_HO Own Construct Hands-On (Q59, Q60)	18	1.00	5.00	3.5278	1.0357
MPS_D MPS Delegating (Q43, Q44)	18	1.50	5.00	3.1944	1.1000
MLQ_MBE MLQ Management by Exception (Q12, Q15)	18	1.00	4.00	2.3611	.8542
MLQ_LF MLQ Laissez-Faire (Q16, Q17)	18	1.00	2.50	1.2778	.5208
Valid N (listwise)	9				

Reliability for Impact Scales

	Reliability for Scales = Alpha
MPS_PS MPS Problem Solving (Q35, Q36, Q37)	.7693
MPS_M MPS Monitoring (Q31, Q33, Q34)	.7095
OC_S Own Construct Strategizing (Q51, Q52, Q53, Q54, Q55)	.8340
OC_CC Own Construct Calm and Composed (Q6r, Q7r, Q8r, Q13r reverse, Q14r reverse	.6589
MLQ_CR MLQ Contingent Rewards (Q9, Q10)	.8889
OC_M Own Construct Monitoring (Q48, Q49, Q50)	.9115
MPS_R MPS Recognizing (Q28, Q29, Q30)	.8862
MPS_CRO MPS Clarifying Roles and Objectives (Q21, Q22)	.8361
MPS_S MPS Supporting (Q38, Q39)	.6400
MPS_PO MPS Planning and Organizing (Q18, Q19)	.2708
MPS_MC MPS Managing Conflict (Q41, Q42)	.6506
MLQ_TRAN MLQ Transformational (Q2, Q3, Q4, Q5)	.8070
OC_T Own Construct Teaching (Q56, Q57, Q58)	.9051
MPS_MI MPS Motivating and Inspiring (Q26, Q27)	.7827
MPS_C MPS Consulting (Q23, Q24, Q25)	.8167
OC_DB Own Construct Directive Behavior (Q45, Q46, Q47)	.6534
OC_HO Own Construct Hands-On (Q59, Q60)	.9851
MPS_D MPS Delegating (Q43, Q44)	.6627
MLQ_MBE MLQ Management by Exception (Q12, Q15)	.3042
MLQ_LF MLQ Laissez-Faire (Q16, Q17)	.6145
Valid N (listwise)	9

ANSWERS TO FILL IN THE BLANK QUESTIONS

ID #	TENURE	POSITION	GENDER	TEAM	LEADER IN BAY	MOST EFFECT LEADERS	LEAST EFFECT LEADERS
1	1 Day	Resident	Male	A	Surgical Fellow	considerate and confident	domineering
2	4 Years	Nurse	Male		Surgical Attending, Fellow, RN	are present at each resuscitation and have a positive outlook and focus on treatment plan leading to disposition in a timely manor	Absent
3	5 Days	4th Year Medical Student	Female	A	Attending surgery, chief surgery, resident	oversee that ABCs and 2nd survey are being managed appropriately, follow-up on Xrays, CTs, encourage	only put down staff
4	5 Years	Nurse	Female		1) Surgical Fellow, 2) Attending, 3) If 1 & 2 not available anesthesia attending	designate assignments to other team members, communicate plan of care to nursing, evaluate quality of team work	are not present at admission, yell and scream at team, openly belittle team members, generally not available
5	2 Days	Medical Student	Female	A	attending, chief resident	direct care while trusting other team embers to perform tasks	portray negative attitudes
6	7 Years	Trauma Tech	Female		nurse, attending	have been there for more than 2 years	won't listen to anyone--some residents
7	3 Weeks	Resident	Male	A	attending surgeon, surgical fellow, resident accepting physician	are decisive and assign tasks to assistants	do not remain calm, criticize people attempting to help
8	18 weeks	Resident	Male	A	Surgical fellow, surgical attending, resident designated to care for patient	who take initiative, lead the team by example, act as patient advocates, provide clear objectives and goals to team, are superior teachers	unavailable, not set example of leadership, show no interest, do not have solid base of knowledge
9	5 Months	Trauma Tech	Female		fellow / attending	step back, closely observe and let the team actively participate and make decisions	does not let team actively make treatment decisions
10	2 Months	Nurse	Female			fellows	medical students

ANSWERS TO FILL IN THE BLANK QUESTIONS CONTINUED

ID #	TENURE	POSITION	GENDER	TEAM	LEADER IN BAY	MOST EFFECT LEADERS	LEAST EFFECT LEADERS
11	5 Months	surgery resident	Male	B	attending surgeon or fellow	actively participates in trauma resuscitation, delegates specific tasks and them ensure that treatment plan is carried out efficiently	do not aggressively and efficiently carry out treatment plan
12	1.5 Years	Nurse	Male		attending surgeon / anesthesiologist & fellow	*Can not read*	*Can not read*
13	2 Weeks	Resident	Female	B	Resident in charge of patient	take control of their patient and lead resuscitation assigning people to specific jobs	do not dictate the crew and let everyone know the plan
14	13 Years	Nurse	Female		The nurse, the surg attending, the anest attending. Not in any special order, it depends on the patient and who is present	provide direct hands on care, have leadership ability, are confident and knowledgeable about trauma resus	have no leadership skills, do not really care about patients or trauma (I.E. just doing their time)
15	8 Months	Nurse	Male			are patient, good followers of protocol	think they know a lot, medical students, interns
16	9 Years	Trauma Tech	Male		Primary nurse to senior Doctor		do not offer help or information regarding the patient or treatment of the patient
17		Medical Student	Female	B	attending surgeon		
18	3 Days	Medical Student	Female	B	surgical fellow	are calm and pleasant with staff	

ANSWERS TO FILL IN THE BLANK QUESTIONS CONTINUED

ID #	Tenure	Position	Gender	Team	Leader in Bay	Most Effect Leaders	Least Effect Leaders
19	3 years	Attending Surgeon	Male	B	Different persons can have have to assume leadership during any given resuscitation depending on the available resources and the problems at hand. I.E. The anesthiesologist must assume leadership whenever airway management is critical and the senior most surgical team member should assume leadership in evaluation and initial resuscitation.	Works with the team for the patient	Only see/recognize themselves. Disrupt team dynamics to avoid ??? from the narrow path of what they conceive to be "right".
20	10 Years	Anesthesilo gist	Male		Surgical fellow with back up from surgical attending also anesthiology attending	Coordinate the team. Determine priorities and ensure that they are carried out. Effective leaders make the right diagnoses and get investigation done in a logical sequence anticipating potential difficulties	Don't communicate, often absent, don't monitor crew performance, fail to make decisions, do the ??? and illogical investigations
21	4 Years	Surgical Attending	Male		Surgical Attending #1, Surgical Fellow #2	Do lot lsoe perspective or composure	Lose perspective and/or composure
22	9 Years	Anesthesilo gist	Male		Surgical Attending, Truama Fellow, Anesthesilogy Attending, Admitting Resident		
23	8.5 Years	Attending Anesthesiol ogist	Male		Attending Surgeon	Remail Calm	Get Excited

ANSWERS TO FILL IN THE BLANK QUESTIONS CONTINUED

ID #	Tenure	Position	Gender	Team	Leader in Bay	Most Effect Leaders	Least Effect Leaders
24	18 Years	Anesthesiol ogist	Male		Attending Surgeon, Anesthesiologist, Surgical Fellow	Train the person ahead of tiem, organized goals and treatment, allow the crew function independently under observation.	Those who do not communicate with crew members and expect the others to be mind readers. They become nervous and mistreat the patient.
25	6 Years	Director	Male		Trauma Attending Surgeon	Teach the team their roles, organize well, are present and available. But not micromanaging	Lose their cool, are absent, micromanage
26	2.5 Years	Anesthesia Attending	Male		1. Surgical Attending, 2. Anesthesia Attending, 3. Surgical Fellow	Delegate and empower their team liberally while still paying attention to the small details.	Give no direction and are not present.
27	6 Years	CRNA	Male		Team Attending, Anesthesia CRNA or MDA, TRU Nurse	Stay focused and understand their team members. Know their strengths and weakeness. Don't let anyone flounder	Overreact, inattentive, inexperienced.

ANSWERS TO FILL IN THE BLANK QUESTIONS CONTINUED

ID #	Tenure	Position	Gender	Team	Leader in Bay	Most Effect Leaders	Least Effect Leaders
24	18 Years	Anesthesiol ogist	Male		Attending Surgeon, Anesthesiologist, Surgical Fellow	Train the person ahead of tiem, organized goals and treatment, allow the crew function independently under observation.	Those who do not communicate with crew members and expect the others to be mind readers. They become nervous and mistreat the patient.
25	6 Years	Director	Male		Trauma Attending Surgeon	Teach the team their roles, organize well, are present and available. But not micromanaging	Lose their cool, are absent, micromanage
26	2.5 Years	Anesthesia Attending	Male		1. Surgical Attending, 2. Anesthesia Attending, 3. Surgical Fellow	Delegate and empower their team liberally while still paying attention to the small details.	Give no direction and are not present.
27	6 Years	CRNA	Male		Team Attending, Anesthesia CRNA or MDA, TRU Nurse	Stay focused and understand their team members. Know their strengths and weakeness. Don't let anyone flounder	Overreact, inattentive, inexperienced.

Appendix N.

Leadership behavior impact and frequency data

Impact and Frequency Questionnaire

The following questionnaire was administered to assess frequency and impact of leadership behaviors on team activity. Questions 2-60 were rated by participants both for **frequency** (how often these activities or traits were observed in the leader) and for **impact** (how much of an effect these traits in a leader had on team performance). The respondents rated each question on both dimensions.

Frequency portion of each question was scored on the following five-point scale:
[1] Not at all common: I *rarely* observe this leader behavior.
[2] A little common: I *occasionally* observe this leader behavior.
[3] Somewhat common: I *sometimes* observe this leader
[4] Very common: I *often* observe this leader behavior.
[5] Extremely common: I *usually* observe this leader behavior.

The scale for the **impact** portion of each item was the following five-point scale:
[1] A negative impact.
[2] No impact.
[3] A slightly positive impact.
[4] A moderately positive
[5] A very positive impact.

The remaining questions (61-67) were open questions with written responses.

Question:

1. [not scored/demographics]
2. Express confidence that the crew will perform well
3. Talk enthusiastically about what needs to be accomplished
4. Seek differing perspectives when treating the patient
5. Get the crew to consider different treatment options for the patient
6. Remain calm throughout patient treatment
7. Be composed and unflappable
8. Speak to other crew members in an unexcited manner
9. Give credit to members of the crew when they do their job well
10. Express satisfaction with members of the crew when they do a good job
11. From an opinion regarding the severity of the patient's injuries
12. Focus attention on irregularities, mistakes, exceptions, and deviations from standards
13. Be anxious during patient treatment
14. Express excitement during patient treatment
15. Tell members of the crew what they have done wrong rather than what they have done right
16. Be absent when needed
17. Avoid making decisions
18. Determine priorities for different actives and plan an appropriate allocation of available resources among the activities
19. Plan in detail how to accomplish a major task or project (e.g., identify necessary action steps, when each should be done, and who should do it)
20. Raise his/her voice at a patient
21. Clearly explain crew members' responsibilities in treating the patient

22. Clarify roles and objectives to crew members
23. Consult with crew members to get their reactions and/or suggestions
24. Encourage crew members to express any concerns or doubts about the plan for diagnosing and treating the patient
25. Seek information from crew members in order to determine the course of action
26. Develop enthusiasm by appealing to crew members' pride in accomplishing a challenging task
27. Describe an inspiring vision of what can be accomplished with cooperation and support from the crew
28. Compliment crew members for demonstrating unusual skill in performing a task
29. Express personal appreciation for crew members who display special effort
30. Recognize the work and accomplishments of crew members
31. Check on the quality of work
32. Pay attention to the patient
33. Check work progress against plans to see if it is on target
34. Monitor the work of crew members
35. Identify constraints preventing effective treatment and find ways to eliminate or circumvent them
36. Handle treatment-related problems and crises in a confident and decisive manner
37. Solve problems relating to the treatment of patients
38. Give crew members encouragement and support when they had a difficult and stressful task to do
39. Be sympathetic and supportive when crew members are worried or upset
40. Be present at the start of treatment
41. Propose a reasonable compromise to resolve a disagreement
42. Attempt to resolve conflict between crew members
43. Delegate to crew members the authority to make important decisions and implement them without his/her approval
44. Encourage crew members to determine for themselves the best way to carry out an assignment or accomplish an objective
45. Ask a crew member to perform a specific task
46. Direct crew members to carry out a specific task
47. Tell crew members what to do
48. Monitor crew members' actions to be sure that the patient receives appropriate care
49. Oversee crew members' treatment of the patient
50. Watch the crew in order to prevent errors in their treatment of hte patient
51. Set goals and priorities for treating the patient
52. Provide a general game plan for the treatment of the patient
53. Tell the crew what strategy to use in treating the patient
54. Communicate an overall plan for the crew to follow in treating the patient's injuries
55. Decide what tests or treatments the patient should receive
56. Teach one or more crew members how to perform a task
57. Explain to one or more crew members precisely how to perform a specific task
58. Train crew members to perform specific tasks
59. Actively participate in treating the patient
60. Provide hands-on treatment of the patient

Write-in questions (not scored for impact and frequency)

61. Tenure in TRU
62. Position on team
63. Gender
64. Team membership (A, B or C)
65. Leader in bay
66. Most effect leaders were leaders who...
67. Least effect leaders were leaders who...

Appendix O.

Publications and Presentations related to the Distant Leadership project

Peer Reviewed Publications

F. Jacob Seagull, Colin Mackenzie, Marilyn Sue Bogner, Anju Sidhu, Ross Davis, Yan Xiao (2002). Combining Experts and Video Clips: Ergonomic Analysis for Safer Medical Instrument Trays. *Proceedings of Human Factors and Ergonomics Society 46th Annual Meeting*, 1516-1520

Xiao, Y. et al. (2001). Structures of Trauma Resuscitation Teams With Local and Distant Leaders: A Communication Analysis. Symposium on Distant Leaders, Scottsdale, Arizona

Xiao, Y. (2001). Understanding Coordination in a Dynamic Medical Environment: Methods and Results. M. McNeese, E. Salas, & M. Endsley (Eds.): *New Trends in Collaborative Activities: Understanding System Dynamics in Complex Environments,* Santa Monica, CA: Human Factors and Ergonomics Society, 242-258

Xiao, Y., & Moss, J. (2001). Practice of High Reliability Teams: Observations in Trauma Resuscitation. *Proceedings of Human Factors and Ergonomics Society 44th Annual Meeting,* p. 395-399

Xiao, Y., Via, D., Kyle, R., Mackenzie, C.F., & Burton, P. (2000). Stress with Simulated Trauma Management Measured Salivary Amylase. *Anesthesiology*, 93(34): A-1226

Yan Xiao, F. Jacob Seagull, Colin F. Mackenzie, Katherine Klein, Jonathon Ziegert (2002). Adaptation of team structure of trauma resuscitation teams, *Proceedings of Human Factors and Ergonomics Society 46th Annual Meeting*, 569-573

Yan Xiao, Jacqueline Moss, Colin F. Mackenzie, F. Jacob Seagull, & Samer Faraj (2002). Transactive responsibility systems and high reliability teams: a tentative formulation. *Proceedings of Human Factors and Ergonomics Society 46th Annual Meeting*, 1428-1432

Yun, S., Faraj, S., Xiao, Y., Sims, H.P. ,Jr. (2003). Team leadership and coordination in trauma resuscitation. In. Beyerlein, M.M., Johnson, D.A., & Beyerlein, S.T. (Eds.): Team-Based Organizing, JAI: Amsterdam, pp. 189-214

Klein, K. J. & Ziegert, J. (In press). Commentary: Leader development issues and challenges. In D. V. Day, S. J. Zaccaro, & S. M. Halpin (Eds.), Leader development for transforming organizations. Hillside, NJ: Laurence Erlbaum.

Presentations

Ziegert, J. (2001). Team Leadership: A Review and Extension of Existing Theory Through a Qualitative Study of Shock Trauma Teams. Academy of Management Annual Meeting.

Ziegert, J., Klein, K. J., & Xiao, Y. (2001). Team leadership: A review and extension of existing theory through a qualitative study of shock trauma teams. Academy of Management, Washington, DC.

Klein, K.J., Ziegert, J., & Xiao, Y. (2001). Action team leadership: A multi-method examination of emergency medical teams. Society for Industrial and Organizational Psychology, Toronto.

Submitted for Review

Eileen B. Entin, Fuji Lai, Colin Mackenzie, Yan Xiao, F. Jacob Seagull, Debra Malone, Lisa Neal. Scenario-Based Teamwork Skills Training for Geographically Distributed Teams. Submitted to 2003 HFES Annual Meeting.

Yan Xiao, F. Jacob Seagull, and Colin Mackenzie, Jonathan Ziegert, and Katherine J. Klein. Team Communication Patterns as Measures of Team Processes: Exploring the Effects of Task Urgency and Shared Team Experience. Submitted to 2003 HFES Annual Meeting